Can peripheral arterial disease be early screened in a podiatric setting? A preliminary study in a cohort of asymptomatic adults

S. D’ADDATO¹, E. TARTAGNI¹, A. DORMI², G. BALLARINI³, M. MACCIANTELLI⁵, A.M. MALAGONI³, F. MANFREDINI³, R. MANFREDINI³⁴, C. BORGHI¹

¹Department of Internal Medicine, Aging and Nephrologic Disease, University of Bologna, Bologna, Italy
²Department of Medicine and Public Health, University of Bologna, Bologna, Italy
³Vascular Diseases Center, University of Ferrara, Italy
⁴Department of Clinical and Experimental Medicine, School of Medicine, University of Ferrara, Italy
⁵School of Podiatric Medicine, Istituti Ortopedici Rizzoli, University of Bologna, Bologna Italy

Abstract. – BACKGROUND: Peripheral arterial disease (PAD) is a strong marker of cardiovascular disease but remains an under-diagnosed problem. Moreover, PAD frequently leads to foot problems requiring particular care and surveillance.

AIM: The aims of this study were (1) to determine the prevalence of undiagnosed PAD in a cohort of asymptomatic subjects referred to a podiatric clinic and (2) to evaluate whether a four-item form assessing medical history for the presence of cardiovascular risk factors could identify subjects at high risk for asymptomatic PAD.

PATIENTS AND METHODS: This study included 717 consecutive subjects (121 males, age 50.9±13.9 y) referring to a podiatric clinic who were asymptomatic for PAD and free of cardiovascular disease. The ankle brachial index (ABI) was measured in all subjects. Each subject also completed a self-administered form to identify cardiovascular risk factors.

RESULTS: Among the entire cohort, the prevalence of PAD was 8.3% in males and 1.2% in females. Three subgroups were identified according to the number of risk factors reported (no risk factors, one risk factor, and two or more risk factors), and the prevalence of PAD differed between each subgroup (0.2%, 3.2%, and 18.9%, respectively; p < 0.001).

CONCLUSIONS: In an unselected cohort of subjects referring to a podiatric clinic, who were asymptomatic for PAD and free from cardiovascular diseases, a remarkable prevalence of PAD was found among subjects reporting a minimum of two cardiovascular risk factors. In a podiatric setting, screening with a self-administered form for the presence of cardiovascular risk factors might lead to an early diagnosis of PAD.

Key Words: Cardiovascular disease, Peripheral arterial disease, Podiatry, Prevention, Risk factors.

Introduction

Peripheral artery disease (PAD) is a manifestation of systemic atherosclerosis which leads to a significant narrowing of the arteries distal to the aortic arch bifurcation. Its prevalence increases directly with the longevity. Diagnosis is extremely important, since PAD not only threatens the limbs, but is also associated with a significant increase in morbidity and mortality. The strong association between PAD and other atherosclerotic disorders (e.g., coronary artery disease and cerebrovascular disease¹⁵) and higher rates of death and myocardial infarction after percutaneous coronary intervention⁶ makes PAD a strong marker of cardiovascular disease. The cardinal symptom of PAD is intermittent claudication, but the majority of subjects are asymptomatic³⁷. The standard office-based test to determine the presence of peripheral vascular disease is calculation of the ankle-brachial index (ABI)¹²¹³ but this method remains underutilised. Therefore, PAD remains an under-diagnosed circulatory problem in the primary care setting¹⁴¹⁵.

Since the slight ischemic condition in asymptomatic PAD may encourage the development of foot problems and since PAD prevalence has been linked to the traditional atherosclerotic risk factors such as smoking, diabetes mellitus, hyperlipidaemia, and hypertension⁹, this study aimed (1) to determine the prevalence of undiagnosed PAD in a cohort of asymptomatic subjects referring to a podiatric clinic and (2) to evaluate whether a four-item form, that assessed the medical history for the presence of cardiovascular risk factors, could identify subjects at higher risk for PAD.
Patients and Methods

A total of 749 consecutive subjects (132 males, 52.1±14.9 y, range 22-93 y) were independently referred to a podiatric clinic to foot care for quite common defects (i.e., callosity, onychocryptosis, etc.) and were recruited into the study. Informed consent was obtained from all subjects. The study did not require approval from the Ethical Committee since it was an observational and ecologic study without the use of drugs or other invasive treatments.

Exclusion criteria were as follows: coronary artery disease, history of myocardial infarction or coronary revascularisation procedure, cerebrovascular events (stroke or TIA) or PAD (previous peripheral revascularisation procedure or presence of intermittent claudication. Patients with body mass index (BMI) > 29 were also excluded.

Form for Cardiovascular Risk Factors

A self-administrated form, developed by the Authors, meant to detect cardiovascular risk factors was given to each subject (Table I). Subjects were asked if they were smokers or had been smokers and if they suffered from or were taking drugs for hypertension, diabetes, or hypercholesterolemia.

Ankle Brachial Index (ABI) Evaluation

The ABI was measured by a trained operator. Subjects were evaluated while supine, after a five-minute rest. A cuff was placed on each arm and ankle, and a Doppler ultrasonic instrument (Super Dopplex Huntleigh Technology, UK) was used to detect each pulse. The cuff was inflated to 10 mmHg above systolic pressure and deflated at 2 mmHg/s. The first reappearance of the pulse was taken as the systolic pressure. The systolic pressure was taken a second time, and the two values were averaged. If any pair of values differed by more than 6 mm Hg, repeated pressures were taken, and the average of the most consistent pair was used for subsequent analysis. Pressures were obtained in the following order: left and right arm, followed by the dorsalis pedis and posterior tibial arterial pressures on the side investigated. The highest systolic pressure measured in the arms was selected as the brachial artery pressure measurement. The higher of the dorsalis pedis and posterior tibial pressures was selected as the ankle pressure measurement. The ABI was counted as pathological when the value was < 1 (including subjects with borderline PAD with ABI 0.90 to 0.99) or > 1.5, since this ratio is associated with arterial calcification and increased wall stiffness. For diabetic subjects, and ABI > 1.3 was considered pathological.

Statistical Analysis

Data are presented as mean±standard deviation. A descriptive analysis of the sample was performed by identifying the percentage distribution of risk factors within the population. The prevalence of ABI < 1 was assessed in the whole population and in three subgroups defined by dividing the sample according to the number of cardiovascular risk factors (group A: no risk factor; group B: one risk factor; group C: two or more risk factors).

The differences between ABI values measured in the three subgroups was evaluated by means of a one-way analysis of variance (ANOVA) test. A chi-square test was applied to determine

<table>
<thead>
<tr>
<th>Sex/Age</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been told by a doctor that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. You have high blood pressure?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Your blood pressure values are higher than 140/90 mmHg?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>You should take drugs for high blood pressure?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. You have high cholesterol in your bloodstream?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>You have a cholesterol value higher than 240 mg/dl?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>You should take drugs for high cholesterol?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. You have diabetes?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>You have blood glucose values higher than 120 mg/dl?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>You should take drugs for diabetes?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4. Are you or have you been a smoker (cigarettes)?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
whether statistical significance existed in the percent distribution of subjects with ABI < 1 in the three subgroups. A p-value of 0.05 or less was considered to be statistically significant.

Statistical analyses were performed using SPSS®, MS Windows version 15 (SPSS Inc., Chicago, IL, USA).

**Results**

Thirty-two subjects (11 males, 21 females) reported a history of cardiovascular disease and were excluded from the study. Overall, 717 subjects (121 males, 596 females, age 50.9±13.9 y) were included in this study.

**Form for Cardiovascular Risk Factors**

A total of 68% of subjects (n=485, 44 males, 441 females, age 45.9±11.3 y) did not report any risk factors, and 32% of subjects (n=232, 7 males, 155 females, age 61.3±13.2 y) reported one or more risk factors. The prevalence of hypertension was 37.1% among men and 11.5% among women. Hypercholesterolemia was present in 28.8% of men and 10.0% of women. Diabetes was reported by 10.6% of males and 3.3% of females. Smokers accounted for 20.5% of males and 8.9% of females.

To evaluate whether PAD prevalence was related to the number of cardiovascular risk factors, subjects were divided into three groups: (1) subjects with no risk factor (n=485, 44 males, 441 females, age 45.9±11.3 y); (2) subjects with one risk factor (23%, n=163, 37 males, 126 females, age 59.1±13.5 y); and (3) subjects with two or more risk factors (10%, n=69, 40 males, 29 females, age 66.4±10.7 y).

**Ankle Brachial Index Evaluation**

Among the entire study population, 8.3% of males (n=10, age 64.0±14.6 y) and 1.2% of females (n=7, age 72.5±6.7 y) exhibited an ABI < 1 (mean value=0.93±0.04). No one presented with an ABI > 1.5. No diabetic subject presented with an ABI > 1.3.

In subjects with ABI < 1, the prevalence of risk factors were as follows: 76.2% hypercholesterolemia, 52.4% hypertension, 14.3% diabetes, and 0% smokers.

In groups defined by the number of risk factors reported, ABI values differed significantly (group 1: 1.24±0.07, group 2: 1.14±0.08, and group 3: 1.06±0.09, p < 0.0001) (Figure 1).

Among the three groups, a significant difference in PAD prevalence was found (group 1: 0.2%; group 2: 3.2%, and group 3: 18.9%, chi square test = p < 0.001).

**Discussion**

This study demonstrates that in an unselected cohort of subjects referring to a podiatric clinic who were asymptomatic for PAD and free from cardiovascular diseases, a relevant prevalence of ABI values < 1 was found in the sub-group with two or more cardiovascular risk factors, as detected by means of a 4-item self-administered form. The prevalence of PAD in the cohort overall was 8.3% in men and 1.2% in women, but when two or more risk factors were present, the prevalence increased up to 18.9%. Although under the usual dichotomous categorization of ABI, values 0.9 are usually considered “normal”, we considered an ABI cut-off value < 1 to also account for subjects with borderline PAD (range between 0.9-1.1) who were found to have increased cardiovascular risk compared to subjects with ABI > 18.

The prevalence results observed in this study are very much in line with previous studies conducted in other countries and settings to evaluate PAD prevalence and its association with cardiovascular risk factors7,10,11,18-21. In these studies, as in our observations, a significantly larger number of subjects were asymptomatic, confirming that claudication identifies only the tip of an ice-
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berg, and that lack of awareness of this condition makes PAD an under-diagnosed disease whose true prevalence is under-estimated. Additionally, both the substantially increased risk of premature death and severe vascular events in PAD vs. non-PAD patients and the similar risk of mortality in symptomatic vs. asymptomatic patients with PAD call for early detection of PAD. With this in mind, we aimed to conduct a study to evaluate whether PAD could be recognised using an easy and low-cost procedure. The podiatric outpatient clinic setting was considered optimal for two reasons. First, it could represent a strategic observatory for detecting asymptomatic and undiagnosed PAD, since slight ischemic conditions could favour foot problems. Second, podiatric procedures are quite simple – e.g., removal of callosity, removal of hardened area of skin in plantar area, cut on a nail bed of pellicles, use of keratolytics and acids for the treatment of warts in feet – but are not without risk of serious complications if patient comorbidities are not taken into account. PAD in particular undoubtedly predisposes for a more difficult recovery from injuries caused during podiatric treatment. In our study, the prevalence of PAD was found to be dramatically higher in subjects who reported two or more cardiovascular risk factors on a 4-item form. A simple form might be an easy indicator that in asymptomatic subjects referred to a podiatric setting for careful foot management, a more specific evaluation for PAD should be performed when two or more cardiovascular risk factors are detected.

As in our protocol, an additional step for patients at high risk might be ABI measurement, a validated, non-invasive measurement to detect PAD that is easy to perform but requires a skilled operator.

Limitations of this preliminary study are the significantly higher number of women than men in our subject cohort and principally, the lack of measured data on risk factors. However, we preferred the use of patients’ self-reported answers, which would assess the form’s usefulness in large populations and in different settings. In addition the intention to minimize the informations required to the subjects, in order to reduce the complexity of the form and the attention time, led the Authors to focus on the well-known aspects of the atherosclerotic disease excluding even significant insights such as insulin resistance or women state of fertility (pre-menopause or menopause) etc.

In conclusion, in a podiatric clinic, a systematic approach utilising an easy form reinforced by ABI measurement was able to identify a considerable amount of underlying PAD in an asymptomatic patient cohort. Besides requiring particular care and surveillance in the podiatric approach. Further studies regarding the outcome of the subjects might lead to the validation of proposed form.

References


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