

Frequency of Peripheral Arterial Disease Diagnosed by Measurement of the Ankle Brachial Index Among Diabetics with No Symptoms of Intermittent Claudication

Sheryll C. Pleo, Jay Vincent J. Cresencio, Elaine B. Alajar

Department of Internal Medicine, Manila Doctors Hospital, Philippines

Abstract

Objective. The ankle brachial index (ABI) was measured at rest and after the six-minute walk test (6MWT) to determine the frequency of peripheral arterial disease among diabetics with no symptoms of intermittent claudication.

Methodology. A total of 70 participants were enrolled in the study taken from at the outpatient department of Manila Doctors Hospital and Our Lady of Remedies Health Center, Malate from September to October 2011. Based from the blood pressure resting and after the 6MWT, ABI was computed such that a result of < 0.90 is diagnostic of PAD.

Results. Mean age of participants was 60 years (SD + 12.2). Among the participants 74% were females, 63% were hypertensive, and 14% were smokers. Systolic and diastolic blood pressure was 140+18.32, 82+12.3 respectively. Participants who were hypertensive and who smoke was above 30%. ABI classified as non-compressible and borderline was 1.42 % and above 10% respectively. The frequency of PAD using ABI was 33% at rest and 37% after the 6MWT. No severe PAD was seen both resting and after 6MWT.

Conclusion. The frequency of PAD among diabetics with no symptoms of intermittent claudication using ABI seen at the outpatient department of Manila Doctors Hospital and Our Lady of Remedies Health Center was relatively higher after the 6 MWT.

Keywords: *ankle-brachial index, diabetes, intermittent claudication, peripheral arterial disease, six-minute walk test*

INTRODUCTION

Peripheral arterial disease (PAD) is an important complication of diabetes mellitus associated with increased morbidity and mortality, strokes and coronary artery disease.¹ Systemic atherosclerosis is a manifestation associated with increased risk of death and ischemic events. Despite its associations with increased morbidity and mortality, PAD is significantly under-diagnosed and under-treated in the general population.

Lower extremity PAD is a highly prevalent chronic atherosclerotic occlusive disease, estimated to be between 3% and 10% worldwide.² In the Western population, the prevalence of PAD with diabetes ranges from 16%-22%.³⁻⁴ In Asians, 17.7% diabetics were diagnosed with PAD by ABI.⁵ This can manifest with intermittent claudication and may result in vascular surgery or lower limb amputation.⁶ Lower extremity PAD is a serious disease that affects about 5% of Filipinos aged 40 years and older.⁷ In a local study by PhilPAD, (2000) done in the National Capital

Region, 31% of the population were found to have PAD.⁸ In another local study at the Philippine Heart Center involving 62 patients admitted for coronary angiogram, revealed a data positive for PAD by ABI measurement was 30.6%.⁹ Risk factors such as age, race, gender smoking, diabetes, hypertension, dyslipidemia, hyperviscosity and renal insufficiency¹⁰ all contribute to the occurrence of the disease.

Patients with diabetes have a unique problem with PAD as the disease appears to affect distal blood vessels, which together with superimposed neuropathy, increases patient risk, costs, medication and hospitalization.¹¹

The diagnosis of PAD is made from a typical history, physical examination and the ankle-brachial index (ABI) measurement. ABI is a simple non-invasive screening test that is an inexpensive measure of subclinical atherosclerosis. An ABI \leq 0.90 is used to make the diagnosis of PAD and has a sensitivity of 95% and a specificity of 99%.¹²

ISSN 0857-1074

Printed in the Philippines

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Received June 15, 2012. Accepted October 29, 2012.

This paper was presented in the 2012 17th Philippine Society of Hypertension-PLAS Joint Annual Convention-LRI-Therapharma Dr. Yolando Q.M. Sulit Young Investigator's Award. Ballroom A, Crowne Plaza Galleria Manila Hotel. Oral Presentation.(First Runner-up). February 09, 2012.

Corresponding author: Sheryll C. Pleo, MD

Section of Hypertension, Department of Medicine, UIP-PGH

Mailing Address: 113 Teacher's Country Subd. Magdiwang St. Noveleta, Cavite 4105 Philippines

E-mail: yenoct81@yahoo.com

The six-minute walk test (6MWT) is a useful measure of functional capacity targeted at people with at least moderately severe impairment. It is a highly reliable measurement of functional and hemodynamic severity of peripheral arterial occlusive disease.¹³ The test has been widely used for preoperative and postoperative evaluation and for measuring the response to therapeutic interventions for pulmonary and cardiac disease. It evaluates the global and integrated responses of all the systems involved during exercise.¹⁴

There have not been any studies on ABI using 6MWT as a screening tool in identifying PAD among diabetics with no symptoms of intermittent claudication.

OBJECTIVES

The objective of the study is to determine the frequency and severity of peripheral arterial disease among diabetics with no symptoms of intermittent claudication using the ankle-brachial index at rest and after the six-minute walk test.

METHODOLOGY

Design

This is a descriptive study; frequency is defined as the number of participants whose ABI at rest and after the 6 MWT were positive for PAD divided by the total population in the study, respectively.

Study Population

A total of 70 participants diagnosed with type 2 diabetes mellitus with no symptoms of intermittent claudication. The study was approved by the ethics committee and informed consent was obtained from the participants.

Study Setting and Time Period

Outpatient settings (Manila Doctors Hospital and Our Lady of Remedies Health Center Malate) taken from September to October 2011.

Sample-Size Calculations

The study required at least 67 subjects to achieve a 90% probability that the estimate is within the 10% margin of error from the prevalence rate of PAD among diabetics which is 17.7% among Asians.⁵

Data Collection

The study included participants more than 18 years of age diagnosed with type 2 diabetes mellitus from which informed consent was obtained. The participants did not have any symptoms of intermittent claudication. The

following are the exclusion criteria: (1) individuals who have any form of lower limb revascularization, (2) critical limb ischemia, (3) recent history of cardiovascular or cerebrovascular injury and (4) individuals who are unable to perform the six minute walk test due to limb deformities or active arthritis.

1. Ankle-Brachial Index

A Handheld Doppler probe (Nicolet Vascular Pocket Doppler II; Nicolet Biomedical Inc, Golden, Colorado) was used to obtain the highest systolic pressures of the upper and lower extremities (brachial, dorsalis pedis, and posterior tibial arteries respectively). Only one technician performed the test. The ABI was calculated by obtaining the highest systolic blood pressure of the lower extremity divided by the highest systolic pressure of the upper extremity. Patients are then categorized as non-compressible, normal, borderline, mild-moderate and severe PAD.

In this study, the investigators used the current definition of computing the ABI.

The AHA guideline 2005 uses the following parameters in classifying the severity of PAD by ABI.¹⁵

>1.30	- non-compressible
1.0-1.29	- normal
0.91-0.99	- borderline
0.41-0.90	- mild to moderate
0.00-0.40	- severe

Based from Rooke et al 2011 PAD Guideline Focused Update, AHA 2005 Guidelines remains current.¹⁶

2. Six-Minute Walk Test

The 6MWT was performed indoors, along a long, flat, straight, enclosed corridor with a hard surface that is seldom travelled. Each participant was instructed to walk back and forth with usual pace walking. The walk course is 30 meters in length with a 180 degree turn-around points marked with a masking tape. An examiner observes each participant undergoing the test while noting for any discomfort.

The required equipments are: countdown timer (or stopwatch), worksheets on a clipboard, sphygmomanometer, hand-held doppler, ultrasound gel.

Patients were given instructions as follows: (1) To wear comfortable clothing and appropriate shoes for walking should be worn (2) The patient's usual medical regimen should be continued, (3) A light meal is acceptable before early morning or early afternoon tests, and (4) Patients should not have exercised vigorously within 2 hours before the test.

RESULTS

In Table 1, the mean age of participants is 60 years (SD ± 12.2). Fifty-two were females (74%), 18 were males (26%). Sixty-three percent were hypertensive, average systolic and diastolic blood pressure was 140 ± 18.82 and 82±12.39 respectively. Sixteen (36%) participants who were hypertensive are positive for PAD at rest. Of the 14% who were smokers, half were positive for PAD at rest.

Table 1. Clinical characteristics of participants in the study

	N (70)		%
Age in Years	60 + 12.2		
Males	18		26
Females	52		74
Hypertension	44		63
Average BP	Systolic (SD)	Diastolic (SD)	
	140+18.32	82+12.39	
(+) PAD	Resting	6MWT	
	16	15	(36)(34)
Smoking	10		14
(+) PAD	Resting	6MWT	
	5	4	(50)(40)

In Table 2, resting ABI revealed the following results: 1(1.42%) was non-compressible, 35(50%) normal, 11(15%) borderline, and 23(33%) had mild to moderate PAD. After 6MWT, results showed that 1(1.42%) was non-compressible, 31(44%) normal, 12(17%) borderline, 26(37%) had mild to moderate PAD. No participants were classified as severe at resting and after 6MWT. Among males 7 (39%) were classified as mild-moderate at rest as compared to 9 (50%) after the 6MWT. Among females 16 (31%) were classified as mild-moderate at rest as compared to 17 (33%) after the 6MWT.

DISCUSSION

Based on this study, the frequency of PAD among diabetics using ABI seen at the outpatient department of Manila Doctors Hospital and Our Lady of Remedies Health Center was 33% at rest and 37% after the 6MWT. This was higher than the Asian study which was 17.7% but almost comparable to the data done at Philippine Heart Center which was 30.6%.⁷

Stenosis or obstruction is usually localized to large and medium-sized vessels of the lower extremities which are composed of atherosclerotic plaques. These plaques are the pathology in the development not only of the coronaries and cerebrovascular diseases but also with the aorta and arteries of the limbs (peripheral arterial diseases).¹⁷ Patients with coronary and cerebrovascular

diseases have the increased risk of developing peripheral arterial disease.

Table 2 shows that 2 participants were classified as non-compressible. The ABI may underestimate the severity of PAD in patients with non-compressible outcomes due to arterial calcification most commonly in the presence of diabetes mellitus.¹⁸⁻¹⁹ This can be measured further by pulse volume recording (PVR)²⁰⁻²¹ which is accurate up to 90% to 95%.²² More males were positive for PAD both resting and after the 6MWT than in females, this is probably due to age, gender and risk factors that are more commonly seen among males.

The frequency of PAD among smokers and those with hypertension is more than 30%. Cigarette smoking is a major risk factor for PAD and increases the risk of PAD by 2 to 6 fold. On the other hand, hypertension increases pressure in arteries that damages arterial walls, leading to increased risk of claudication, 2.5 to 4 fold in men and women, respectively.⁷

Among the 70 patient volunteers, 8 (31%) showed normal ABI at rest but a fall in the ABI after limb exercise.²³⁻²⁴ This can be explained by an increase in oxidant stress and injury to endothelial cells and fibers during repeated episodes of ischemia during exercise.²⁵ On the other hand, 5 patients (22%) had PAD at rest but showed a negative result after the 6MWT Possible explanations include improvement in endothelial function, skeletal muscle metabolism, blood viscosity and reduction of systemic inflammation. Another would be the increase in blood flow and oxygen delivery to the muscles during exercise.²⁶

In the natural history of patients with PAD, 5 year mortality rate is 15%-30% and approximately one-third to one-half of patients with PAD have evidence of coronary artery disease.¹⁶ Hence, in these patients, it is imperative to reduce their risks for cardiovascular events and mortality. The management includes aggressive lifestyle and risk factor modification particularly optimal control for hypertension, diabetes and dyslipidemia.

These are the limitations of this study:

We may not see severe PAD in this study because the sample size of the estimate was based on the over-all frequency and is not powered to detect the differences in the severity of PAD.

Table 2. ABI classification of participants at rest and after 6MWT

	Resting			6MWT		
	Male	Female	Total	Male	Female	Total
Non-compressible	1 (5.55%)	None	1 (1.42%)	None	1 (1.9%)	1 (1.42%)
Normal	9 (50%)	26 (50%)	35 (50%)	8 (44%)	23 (44%)	31 (44%)
Borderline	1 (5.5%)	10 (19%)	11 (15%)	1 (4.4%)	11 (21%)	12 (17%)
Mild-Moderate	7 (39%)	16 (31%)	23 (33%)	9 (50%)	17 (33%)	26 (37%)
Severe	0	0	0	0	0	0

Baseline diagnostic work-ups were not included in the data collection like fasting blood sugar, HbA1c and lipid profile which could probably benefit in determining control of diabetes and presence of other risk factors.

CONCLUSION

The frequency of PAD among diabetics with no symptoms of intermittent claudication using ABI seen at the outpatient department of Manila Doctors Hospital and Our Lady of Remedies Health Center was 33% at rest and 37% after the 6 MWT.

Since this study only included diabetic patients, for further research, we recommend that the study population may be broadened to include hypertensive and dyslipidemic patients.

Acknowledgements

We would like to thank the following: Dr. Bernadette Tumanan-Mendoza, Dr. Noemi Pestano, Ms. Catherine Lagaya, Post Graduate Interns: Eloise Ann Laron and Maria Grethel Dimalala, for their wisdom, time, support and assistance in this study.

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