ORIGINAL ARTICLE

Relationship of Ankle Brachial Index with Age, Body Mass Index, Smoking and Lipid Profile

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ABSTRACT

Aim: To assess the relationship of Ankle brachial index with age, BMI, smoking and lipid profile.
Method: Cross-sectional observational study conducted on outpatients 150 risk subjects. Subjects were selected on the basis of age >45 yrs for males and 50 years for females along with conventional cardiovascular risk factors including hypertension, obesity, smoking and diabetes. The subjects were divided on the basis of basis of ABI >0.9 and <0.9 into two groups. Fasting samples were collected for laboratory examination of serum glucose, lipid profile. ABI was taken from subjects in supine position after rest of 10 minutes by using hand held Doppler.
Results: We found subjects with ABI >0.9 were comparatively younger than those with ABI <0.9 (p value <0.001).There was no significant difference in BMI but difference was statically significant for waist circumference. 60% subject in group II were smokers as compare to 26% in group I (p value 0.002). It was found that levels of total cholesterol and LDL were higher in group II and p value was statically significant, but non significant for HDL and triglycerides. The correlation of age (r=-0.42) and waist circumference(r=-0.29) with ABI was negatively significant.
Conclusion: Peripheral arterial disease (ABI <0.9) is common in selected risk population but diagnosis is not promptly established. The ABI can be used as bed side technique to detect high risk subjects.
Key words: Ankle brachial index, Body Mass Index, lipid profile

INTRODUCTION

Prevention of Atherothrombotic Disease Network highlighted the need for improving detection and treatment of peripheral arterial disease (PAD) as a largely under diagnosed and under treated deleterious disease. PAD is a powerful predictor of future cerebrovascular and cardiovascular (CV) events such as myocardial infarction and stroke, and of increased mortality[1].

Peripheral arterial disease results in compromised blood flow to the extremities. The most widely accepted definition of peripheral arterial disease is "an ankle brachial index (ABI) less than 0.90, that is the ratio of systolic blood pressure at the ankle (as measured by Doppler ultrasonography) to the systolic blood pressure in brachial artery is less than 0.90". The ankle brachial index <0.90 correlates extremely well with angiogram positive disease [2].

Risk factors for PAD are similar to those associated with coronary artery disease and include hypertension, obesity, diabetes mellitus, hyperlipidemia, smoking and advanced age[3]. PAD is very thrombogenic and consists of large percentage of diabetics, hyperlipidimics and smokers, conditions all associated with endothelial dysfunction and a hypercoagulable state[4].

As an objective, quantitative measure of PAD, ABI is potentially valuable non-invasive tool in the identification of novel determination of PAD.

The ABI is the ratio of resting higher systolic blood pressures between the dorsalis pedis and posterior tibial artery to the higher of the systolic blood pressures in the two of brachial arteries. The ABI correlates closely with intra arterial recordings. This is a very inexpensive, rapid and painless method that can be well standardized and shows a marginal inter observer variability[5].

The ABI provides a simple measurement that can be performed in primary care settings without expensive or elaborate equipment or extensive training or experience. An ABI value <0.9 is widely acknowledged to indicate an abnormally low level[6].

Moreover, it is an inexpensive, accurate, reproducible procedure that does not require specialized personnel. Because of its diagnostic precision and wide spread availability, the ABI is the method of choice for diagnosing PAD, which in most patients is not manifested by symptoms, and should be routinely used when assessing patients at a risk of developing atherothrombotic disease. In addition to its use in the diagnosis of symptomatic PAD, the greatest value of ABI lies in its function as an

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independent predictive marker of cardiovascular death in patients with asymptomatic PAD[7].

The ultrasonic pocket Doppler is an easy to use instrument and helps to make the diagnosis of PAD easier in the asymptomatic patient. With the help of a sphygmomanometer, it is possible to determine the systolic blood pressure in posterior tibial, dorsalis pedis and brachial arteries and thus be able to calculate the ABI[8].

With this background this study was conducted, in order to assess the relationship of ankle brachial index with different coronary risk factors such as age, BMI, smoking and lipid profile.

SUBJECTS AND METHODS

This study was carried out in the Department of Physiology, Basic Medical Sciences Institute, and Jinnah Postgraduate Medical Centre Karachi with collaboration of Department of Medicine Abbassi Shaheed Hospital and Ward 5 Jinnah Post Graduate Medical Centre Karachi from Jan-Mar 2009.

This was cross sectional, descriptive, observational study, involved no therapeutic interventions, performed in out patients. All individuals underwent a complete history and physical examination, as well as basic analyses: glucose, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides subjects were divided on the basis of ABI >0.9 and ABI><0.9 into two groups and compared different variables.

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Group I	Group II
ABI >0.9	ABI<0.9

Participating individuals was selected on the basis of age, sex, & the presence of conventional cardiovascular risk factors: hypertension, obesity, smoking, diabetes, hypercholesterolemia, decreased HDL cholesterol and family history of early cardiovascular disease. Individuals who smoked previously or currently were classified as smokers. Arterial hypertension was defined in subjects receiving antihypertensive medication or in subjects with systolic blood pressure values >140 mmHg or diastolic values >90 mmHg according to the guidelines of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.

Hyperlipidemia was classified in patients with a fasting total serum cholesterol >200 mg/dl, a serum LDL-cholesterol value greater than 130 mg/dl or a serum triglycerides value of greater than 172 mg/dl according to the local standard values. The weight and the height of each patient were measured, and the body mass index (BMI) was calculated using the formula: BMI (kg/m^2)=weight (kg)/height(m^2). Intermittent claudication was defined according to Edinburgh Claudication Questionnaire[9] and classified into three categories: non, atypical and typical.

The hand held pocket Doppler with 8 MHz probe (Sonotrax Vascular, Edan Instrument, Inc. Serial No.STAV0840563) and mercury sphygmomanometer was used to calculate ABI. Specifically the inclusion criteria were for men 1. Age >45 years with one or more risk factors. 2. Age >65 years. 3. Individuals with NIDDM. For women**:** 1. Age >50 yrs with one or more risk factors. 2. Age > 65 years.
3. Individuals with NIDDM
C) Family history of early coronary heart disease.

Exclusion criteria

- Patients were excluded if they have prior evidence of atherosclerotic lesion (myocardial infarction, stroke, angina pectoris).
- Contra-indication of ABI measurement which includes painful inflammatory processes, wounds, phelebitis, extreme edema, If ABI >1.4 this indicate incompressible vessels.
- Hyperthyroidism.
- Uncontrolled neoplastic disease.
- Any acute inflammatory condition

Ethics: A verbal consent of the individuals was taken after explaining the procedure.

All the participants were asked to observe a fast of 12 hours, and to avoid heavy physical activity for at least two hours before test. Then the blood pressure was measured in sitting position after rest of 5 minutes. The participants were then asked to lie down for 5 minutes and then their ABI was measured in supine position. All the participants received a performa, comprising of values and measurements of the following; blood pressure, height, weight, waist circumference, ankle brachial index; the history of Diabetes, hypertension, drugs and smoking.

Statistical analysis: Data analysis was performed using SPSS version 10.0. All continuous response variables like age, weight, fasting blood sugar were presented by mean±SD; Students t-test (unpaired) was applied to compare means of these variables between two groups. The results were considered statistically significant if p ≤ 0.05 and it was taken as highly significant if P-value was less than 0.001.

RESULTS

We have divided subjects on the basis of ABI >0.9 (Group I) and ABI <0.9 (Group II). This table I is showing comparison of variables gender, smoking and Edinburgh questionnaire for intermittent claudication. There was no significant difference observed in gender of both groups. Smoking history was more common in group 2 as compared to group

I. In group II, 16% subjects presented with typical IC and 20% with atypical IC while 64% were asymptomatic that is absent IC as compared to group I where 2.4% subjects presented with atypical IC.

Table II is showing comparison of ABI, age, BMI and waist circumference on the basis of ABI>0.9 (Group I) and ABI<0.9 (Group II). A significant difference was observed in the mean age of two groups. Subjects with ABI>0.9 were comparatively younger than those with ABI<0.9 (p value <0.001). There was no significant difference in BMI but difference was statically significant in waist circumference of two groups.

Table III is showing comparison of lipid profile on the basis of ABI. It was found that the levels of total cholesterol and LDL-cholesterol were higher in group II as compared to group I and p value is statically significant. It was non significant for HDL-cholesterol and triglycerides.

Table IV and V are showing correlation coefficient of ankle brachial index with different variables and lipid profile. A highly significant negative correlation of ABI was found with age, waist circumference, LDL-C and total cholesterol.

Table I: Comparison of gender, smoking and intermittent claudication on the basis of ABI<0.9 (Group I) and >0.9 (Group II)

	Group I **ABI>0.9 (n=125)**	Group II **ABI<0.9 (n=25)**	P value
Male	78 (62.4%)	18 (72.0%)	0.361
Female	47 (37.6%)	7 (28.0%)	
Smoking	35 (28.0%)	15 (60.0%)	0.002**
Edinburgh questionnaire for intermittent claudication			
Definite	0	4 (16.0%)	0.001**
Atypical	3 (2.4%)	5 (20.0%)	
Absent	122 (97.6%)	16 (64.0%)	

** p-value is significant at the 0.05 level*
***p value is highly significant at the 0.001 level*

Table II: Comparison of ABI, age, BMI and waist circumference on the basis of ABI>0.9 (Group I) and <0.9 (Group II)

Variables	**Group I ABI>0.9 Mean±SEM**	**Group II ABI<0.9 Mean±SEM**	**P value**
ABI	1.08±0.006	0.80±0.008	0.001**
Age (yrs)	58.16±0.655	65.24±1.15	0.001**
BMI (kg/m^2)	27.4±0.31	27.5±0.49	0.355
Waist circumference (cm)	90.2±0.64	94.8±1.26	0.002*

** p-value is significant at the 0.05 level*
***p value is highly significant at the 0.001 level*

Table III: Comparison of total cholesterol, triglycerides, HDL-Cholesterol and LDL-Cholesterol ON THE Basis of ABI>0.9 (Group I) and <0.9 (Group II)

Lipid profile (mg/dl)	**Group I ABI>0.9 Mean±SEM**	**Group II ABI<0.9 Mean±SEM**	**P value**
Total cholesterol	206.2±4.27	229.6±9.52	0.027*
Triglycerides	167.5±3.78	170.5±8.45	0.747
HDL-cholesterol	39.9±0.49	37.8±0.99	0.090
LDL-cholesterol	132.8±4.09	157.6±9.53	0.015*

Table IV: Correlation coefficient of ankle brachial index vs age, weight, BMI and waist circumference

		ABI index
Age	Pearson correlation	r=- 0.42**
Weight	Pearson correlation	R= -0.01
BMI	Pearson correlation	R=0.03
Waist circumference	Pearson correlation	R=-0.29**
Smoking	Pearson correlation	R=-0.26**

**Correlation is significant at the 0.05 level (2 tailed)*
***Correlation is significant at the 0.01 level (2 tailed)*

Table V: Correlation coefficient of ankle brachial index vs lipid profile

LDL-cholesterol	Pearson correlation	r = -0.24**
Total-cholesterol	Pearson correlation	r =- 0.22**
HDL-cholesterol	Pearson correlation	r = 0.22**
Triglyceride	Pearson correlation	r = -0.10

**Correlation is significant at the 0.05 level (2 tailed)*
***Correlation is significant at the 0.01 level (2 tailed)*

DISCUSSION

Peripheral arterial disease (PAD) is an important manifestation of systemic atherosclerosis. In this context, the importance of early identification and treatment of PAD has been increasingly acknowledged recently[10]. Limb loss due to necrosis is very rare in PAD patients, more importantly; PAD is a powerful predictor of future cardiovascular and cerebrovascular events such as MI and stroke and of increased mortality. A recent publication by the prevention of Atherothrombotic Disease Network[1] highlighted the need for improving detection and treatment of PAD as a largely under diagnosed and under treated deleterious disease.

Ankle brachial index can be used as a noninvasive method of assessing asymptomatic PAD. It provides important information with respect to subclinical atherosclerosis. In correlation study, it was found that, the sensitivity of ABI for detecting PAD is about 90% and specificity is about 98% when compared to angiography[11]. It is already known that an inverse relationship exists between ABI and cardiovascular disease and that ABI can be a marker for generalized atherosclerotic disease[7,12].

However, these correlations have not been investigated in our population with cardiovascular risk factors. Under these circumstances, the current study was undertaken to evaluate relationship between ABI and cardiovascular risk factors and to determine whether non-invasive measurement can be a useful approach to screen cardiovascular risk individuals.

In our study, application of ABI for detection of PAD had a pronounced clinical impact. Specifically in the sample of risk individuals selected 16.6% had an ABI <0.9 (14% of non diabetic individuals and 26% of diabetic individuals) and consequently presented PAD. It is important to point out that individuals selected were representative of the population seen in internal medicine practice; more over none had history of atherothrombotic disease and treatment they received on primary prevention. These findings were comparable to studies done on ABI in primary care settings. The prevalence of PAD in these studies ranges from 5% to 30% e.g., in Rotterdam study[13].

Our study specifically assessed the selected individuals within the internal medicine setting with vascular risk and no known arterial disease. This population is likely to be one in which ABI determinants may have greatest clinical interest. It is now well established that subjects with low ABI are at an increased risk of both cardiovascular morbidity and mortality. An ABI <0.9 has been consistently associated with 2 to 5 fold increase in all cause death and 3 to 8 fold increase in CV death compared with ABI> 0.9[14,15,16].

When compared on the basis of ABI (<0.9 and >0.9) there was significant difference in mean age of both groups. We have found strong negative correlation between ABI and age. One of the limitations of our study is exclusion of high ABI (>1.4) that is, artery has rigid incompressible wall, presumably due to an arteriosclerotic process. The clinical significance of this finding is still uncertain and almost all the studies exclude these cases from the statistical analysis. Nevertheless, it is reported that an ABI >1.4 is nearly as important prognostic marker of morbidity and mortality as a low ABI[17].

In our study analysis using Pearson correlation showed that age, smoking, waist circumference, SBP and pulse pressure were strongly but negatively associated with ABI index. We did not find association of BMI with low ABI. This is in agreement Fung et al[18] but our finding was in contrast to finding of Hasimu et al[9] and Gabriel et al[19].

Smoking is considered to be one of the most significant risk factors for CVD, in our study, smokers appeared to have a higher risk of low ABI index than non-smokers. A multitude of research has agreed on the strong association between smoking and PAD[9,19,20,21].

The effect of serum lipid levels on low ABI is less clear. It has been suggested that the association between elevated cholesterol levels and PAD seems to be somewhat weaker than that of CHD[22]. In our study we found negative association between total cholesterol and ABI index. Individuals with low ABI index had higher total cholesterol levels. Our finding is comparable with NHANES study[23] and Framingham Study [24]. In the NHANES study, done on individuals older than 40 yrs with total cholesterol of 240 mg/dl had a greater risk ratio of 1.88 for PAD defined by ABI <0.9. Similarly, in the Framingham study people with intermittent claudication had a higher mean cholesterol level; people with total cholesterol >270mg/dl had twice the incidence of developing IC.

There are certain limitations of our study. Because of cross sectional nature of our study we can only describe associations but can not find causal relationships.

CONCLUSION

From this cross-sectional study, it is concluded that:

- PAD (ABI<0.9) is exceedingly common in selected risk population but diagnosis is not promptly established. As for any clinical condition, the diagnosis for PAD is more likely to be accurately established if clinicians utilize specific diagnostic approach.
- Our study suggests ABI as marker of subclinical atherosclerosis. It is a simple, objective, cheap and non-invasive technique that might be used as a routine part of clinical evaluation of individuals at high risk for morbidity and mortality.
- The number of individuals with cardiovascular disease has been increasing due to changes in diet and lifestyle. The screening for atherosclerosis might be particularly useful in future.

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