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RELATIONSHIP BETWEEN ANKLE BRACHIAL INDEX (ABI) AND CARDIOVASCULAR RISK FACTORS IN DIABETES TYPE II

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ABSTRACT

Objective: Cardiovascular disease as a sequel of the phenomenon of atherosclerosis is significant reason of morbidity and mortality among population worldwide and ankle brachial index (ABI) is one very significant indicator of its happening. Thus to correlate ABI with risk factors is one step to prevent atherosclerotic phenomenon as a low value of ABI is an indicator of cardiovascular disease. The focus of this research is to find relationship between ABI and the risk factors that lead to cardiovascular disease.

Methodology: The study was piloted at the Diabetes Clinic, Medical Unit III, Jinnah Postgraduate Medical Centre Karachi for a duration of six months from March 2019 to August 2019. It was a cross-sectional study. One hundred and twenty-one adult type 2 diabetic consecutive patients participated in the study.

Results: Peripheral artery disease was present in 35(29%) patients among which 7(20%) were males and 28(80%) were females. (p=0.007). PAD was more frequent in middle age group and hypertensive patients. Patients with dyslipidemia and metabolic syndrome had a higher frequency of PAD. The PAD increased with duration of diabetes and a sedentary lifestyle. Smoking was not a very significant factor in PAD. The frequency of PAD rose with a higher BMI.

Conclusion: The study concluded that there is a co-relation between a low ankle brachial index and risk factors like uncontrolled hypertension, an increased BMI, waist circumference or duration of diabetes, or the presence of dyslipidemia, metabolic syndrome or sedentary lifestyle.

Keywords: Peripheral arterial disease, Type 2 diabetes, Ankle brachial index, cardiovascular risk factors

INTRODUCTION

Cardiovascular disease (CVD) is a broad term referring to all pathological circumstances that eventually affect the heart or the circulatory system. This embraces all conditions like coronary artery disease, ischemic heart disease, stroke, and peripheral vascular disorders. Thus preventing cardiovascular disease is an important step towards decreasing morbidity and deaths in a community. Its risk factors need to be identified and evaluated early in order to reduce the rate of complications and high mortality.

The ankle-brachial index (ABI) is calculated by dividing the higher systolic blood pressures in each foot's posterior Tibial artery and Dorsalis Pedis artery by the higher systolic blood pressure of the brachial artery. It is an easy and most importantly noninvasive test with good specificity and sensitivity for the diagnosis of peripheral artery disease (PAD). Many studies have commended its worth in the early diagnosis of coronary artery disease (CAD) or ischemic heart disease (IHD).[1] The existence of diabetes mellitus significantly increases the endangerment of PAD, as well as accelerates its course, making these patients more vulnerable to ischemic events and compromised functional status.[2]

Prior studies show an inverse relationship between ABI to cardiovascular and cerebrovascular diseases along with their risk factors.[3] These researches established ABI≤0.9 as an indicator of atherosclerotic processes. A low ABI is associated with many cardiovascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, smoking history and chronic kidney disease. There is also an association of inflammatory markers like C-reactive protein, interleukin-6, Homocysteine levels with peripheral artery disease.[4] Therefore, a low ABI correlates with an increased risk of disease morbidity and mortality.[5]

Since the burden of CVD is increasing day by day, the use of a non-invasive method for early detection of its risk factors can prove beneficial for disease prevention and treatment. Hence, the rationale of conducting this study is to find relationship between the ABI and the risk factors that can lead to

cardiovascular diseases which will aid in the management of the patients.

METHODOLOGY

The study was done at the Diabetes Clinic, Medical Unit III, Jinnah Postgraduate Medical Centre Karachi for a length of six months from March 2019 to August 2019. It was a cross-sectional research. One hundred and twenty-one consecutive adult type 2 diabetic patients participated in the study. The inclusion criteria were all adult diabetic patients proven through lab tests. The exclusion criteria were non diabetics or age less than 18 years. At the start of the study the required consent was signed. A detailed medical history and physical examination with laboratory tests were conducted on each patient and the data was recorded. The recorded information included age of the patients, history of diabetes mellitus, duration of diabetes, history of hypertension, duration of hypertension, smoking, presence of metabolic syndrome and their lifestyle: whether sedentary or not. Physical activity was assessed by self-report only. The physical examination of study participants included measurement of height, weight, BMI and the waist circumference (WC) by a trained examiner. The blood pressure (BP) was taken with a mercury sphygmomanometer, in the right arm and right ankle of the patients in the supine position, after 5 minutes of rest. Blood samples were taken from ante-cubital vein after a 12 hour overnight fast for measurement of Fasting Plasma Glucose (FPG), total cholesterol (TC), triglyceride (TG), Low Density Lipoprotein cholesterol (LDL-C) and High Density Lipoprotein cholesterol (HDL-C). The duration of diabetes mellitus was grouped as less than 5 years, 5 to 10 years, or more than 10 years. The sedentary life style was termed as anyone who did not do 30 minutes of moderate-intensity physical activity, five days in a week, or daily 20 minutes of more of physical activity. A smoker was said to be one who had smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes or had quit recently. Hypertension was considered as someone having systolic blood pressure more than 130mmHg and diastolic blood pressure of more than 80 mmHg. The body mass index was calculated as weight in kg divided by height squared in meters (Kg/m^2). The

Asian cut-off was used for defining overweight and obesity. The waist circumference was measured at a point midway between the last rib and the iliac crest and with the patient at minimal inspiration. Abdominal obesity was defined as a waist circumference more than 90 cm for men and more than 80 cm for women.

Controlled Diabetes was termed when the HbA1$_c$ was less than 6.5. Dyslipidemia was defined on the basis of the presence of any of the following; a high triglyceride level (>150 mg/dL) or drug treatment for high triglycerides, a high LDL-cholesterol level (>100 mg/dL) or drug treatment for high LDL, a low HDL-cholesterol level (men <40 mg/dL, women <50 mg/dL) or on drug treatment. According to the NCEP ATP III definition, metabolic syndrome was present if three or more of the following five criteria were met: waist circumference over 40 inches (men) or 35 inches (women), blood pressure over 130/85 mmHg, fasting triglyceride (TG) level over 150 mg/dl, fasting high-density lipoprotein (HDL) cholesterol level less than 40 mg/dl (men) or 50 mg/dl (women) and fasting blood sugar over 100 mg/dl.[6]

According to the current guidelines of the American Heart Association (AHA) and the Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II), ABI was defined as the ratio of the higher of the systolic blood pressures of the 2 ankle arteries of that limb (either the Dorsalis Pedis or the Tibial artery) and the higher of the 2 systolic blood pressures of the upper limbs at the time of presentation. Ankle brachial index (ABI) = (Highest systolic blood pressures of the 2 ankle)/(highest systolic blood pressure in both arms). Peripheral arterial disease (PAD): PAD was labeled as "Yes" for the patients with ABI ≤ 0.9 otherwise were labeled as "No".[1] The severity of peripheral arterial disease (PAD) was grouped as Mild: ABI between 0.8 to 0.9, moderate: ABI between 0.4 to 0.79, severe: ABI less than 0.4, Inconclusive; ABI >1.3.

The data taken was analyzed by SPSS version 21. Data was stated either as the mean ± standard deviation or as percentage. Differences between groups was tested using an independent two sample t-test for continuous variables, and the Pearson chi-square test was used to test for differences in the distribution of categorical variables. All provided p values represent the results of two-sided tests and p<0.05 was considered statistically significant.

RESULTS

Out of 121 diabetics 20 (17%) were less than 45 years, 61 (50%) were between 45 and 55 years while 40 (33%) were above 55 years. There were 34(28%) males and 87 (72%) females in the study. Peripheral artery disease was present in 35 (29%) patients. It was inconclusive in 10 (8%) and absent in 76 (63%) patients.

Out of the 35 patients with PAD 32 had mild disease while 3 had moderate one. The frequency of PAD with age groups is shown in Figure 1. Out of the 35 diabetics with PAD 7 (20%) were males and 28 (80%) were females (p=0.007). PAD was present in 28 out of 87 females (32%) and in 7 males out of 34 males (20.5%) (p=0.007). The relationship of hypertension with PAD is shown in Table 1.

Figure 1: The frequency of PAD in different age groups. (n=121; p=0.570)
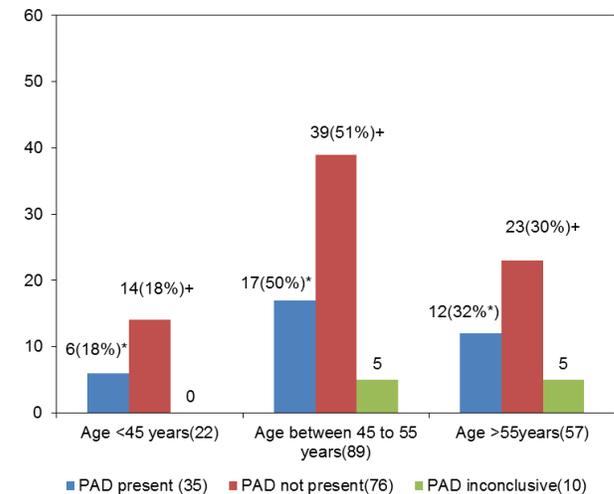
Percentage taken out of the total PAD patients present.
+ Percentage taken out of the total patients not present with PAD

Out of the total 34 males, 31 (92%) had metabolic syndrome from which 6 (19%) had PAD. Shockingly, 6 out of the 7 (87.5%) males who had PAD had metabolic syndrome (p=0.823). Out of 87 females, 83 (95.4%) had metabolic syndrome out of which 25 (30%) suffered from PAD. The 28 females who had PAD, 25 (89%) of them had metabolic syndrome (p=0.171).

Out of the 21 males present with dyslipidemia, 5 (24%) of them had PAD. It was not present in 12 (57%) males and it was inconclusive in 5 (24%)

(p=0.833). All the 87 females in the study had dyslipidemia out of which 28 (32%) had PAD, 56 (64%) did not have it and it was inconclusive in 3 (3%) (p=0.285).

The results for PAD correlated with diabetes duration are given in Figure 2. Out of the 35 adults with PAD, 28 (80%) had a sedentary way of life (p=0.712). Sedentary lifestyle was there in 23 females out of the 28 (82%) with peripheral artery disease. While in the males, 5 of the 7 (71%) males with PAD had a sedentary routine.

Out of the 35 with PAD, 6 (17%) were smokers (p=0.006). The frequency of BMI in different BMI groups in shown in Table 2.

Out of 35 patients with PAD, 33 (96%) had abdominal obesity. Out of 109 adults with abdominal obesity, 33 (31%) had PAD

Figure 2: The frequency of PAD in diabetics with duration of diabetes. (n=168; p=0.989)
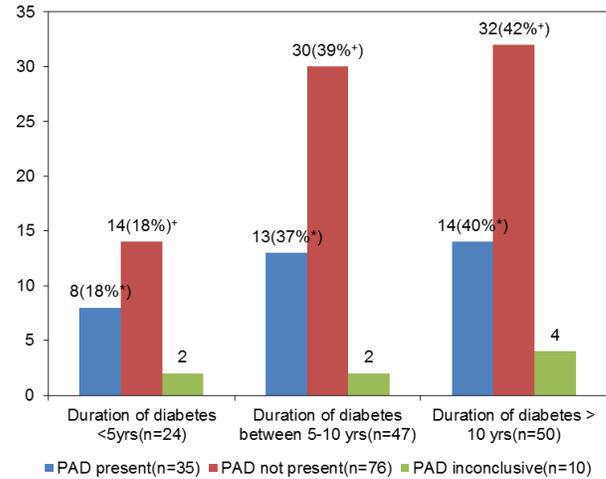
Percentage taken out of the total PAD patients present.
+ Percentage taken out of the total patients not present with PAD.

Table 1: Relationship of hypertension with PAD in both genders. (n=168; p=0.790)

	Males		Female	
	Hypertensive	**Non-hypertensive**	**Hypertensive**	**Non-hypertensive**
N	n=34 (p=0.888)		n=116 (p=0.590)	
PAD present	5 (22.7%)	2 (16.7%)	18 (28.1%)	10 (43.5%)
PAD not present	12 (54.5%)	8 (66.7%)	44 (68.8%)	12 (52.2%)
PAD inconclusive	5 (22.7%)	2 (16.7%)	2 (3.1%)	1 (4.3%)
Total	22	12	64	23

Table 2: The frequency of PAD in different BMI groups

	Males			Females		
	PAD present	**PAD not present**	**PAD inconclusive**	**PAD present**	**PAD not present**	**PAD inconclusive**
N	(n=51; p=0.900)			(n=115; p=0.256)		
Normal	1(12.5%)	4(12%)	1(10%)	5(11%)	15(22%)	1(25%)
Overweight	2(25%)	8(24%)	2(20%)	5(11%)	6(9%)	0(0%)
Obese(1,2,3)	5(62.5%)	21(63%)	7(70%)	32(76%)	48(69%)	3(75%)
Total	8	33	10	42	69	4

DISCUSSION

The frequency of peripheral artery disease was high in this study which is comparable to another local study conducted. There was a difference in the prevalence of peripheral arterial disease in our study

it was 31.6% but in their study, unlike ours, there was no significant difference in the ABI values between males and females.[7] Tanveer's study in 2014 showed a higher PAD frequency overall in diabetics with higher being in females and increased in the age group of 61-70 years[8] in contrast to what we found that the middle age group was more

affected. A 2006 study showed a decreased PAD prevalence but a directly proportional increase of PAD with age group.[9] Mehmood argued that males had a higher prevalence.[10]

The hypertensives had understandably higher atherosclerosis process with a low ABI index. In the 2014 study[8] it was double to the frequency to what we had which could imply a better control of these co-morbids leading to a decline in peripheral artery disease. An aggressive control of hypertension is warranted.

A vast study conducted in United States strongly associated metabolic syndrome with PAD especially the hypertension component.[11] They incorporated the CRP and Fibrinogen in to the metabolic syndrome criteria and the incidence of low ABI increased further. Alexander et al.[12] and Gregorio et al.[13] also emphasized that PAD is more prevalent in patients with metabolic syndrome. The statistics of our study also showed that metabolic syndrome was a cause of accelerated atherosclerosis process.

Peripheral artery disease had been strongly associated with dyslipidemia in numerous studies[14] and a study claims that statin therapy improves claudication symptoms proposing that lowering lipids has a role in improving symptoms.[15]

Nearly all studies[8-10] in diabetic patients agree that the frequency of PAD is proportional to the duration of diabetes which very logically relates to the fact that the atherosclerotic phenomenon is a consistent process that worsens with time.

Sedentary lifestyle is a contributing factor in patients with peripheral artery disease emphasizing on the age long concept of exercise and consistent physical activity. Farah et al.[16] reported more PAD symptoms in patients with a sedentary lifestyle (similar to our results) but the frequency of PAD in her research was more in the males than in females. This is contrary to our finding where it was higher in the females. Richard et al.[17] also demonstrated a significant association between increased physical activity and a lower prevalence of PAD.

Although, smoking had not been a positive correlated factor in our study but it is an established proven fact that smoking aggravates peripheral artery disease.[18,19]

Abdominal obesity and a high BMI have always provoked atherosclerosis. BMI is positively associated with PAD after adjusting for potential confounders. Maintaining an optimal weight, in addition to controlling other cardiovascular risk factors, may play a role in reducing risk of PAD. This was agreed upon by our study and other relevant studies.[20,21]

Peripheral Artery disease lays its impact on patients especially after symptoms start to develop. They have increased rate of functional decline and limited activity compared to those who have not developed PAD. There are higher rates of hospitalization. A focused regular physical activity, weight control, smoking cessation, management of associated risk factors and co morbid has an important impact on the clinical progress of PAD. If a patient symptom does not recover despite proper medications and rehabilitation, invasive procedures should be considered.

Limitations

The study was conducted on a small group of people. A similar study should be conducted on a larger cohort to further address and confirm the associations between these risk factors and peripheral artery disease.

CONCLUSION

The study concluded that there is a relationship between a low ankle brachial index and risk factors like uncontrolled hypertension, an increased BMI, waist circumference or duration of diabetes, or the presence of dyslipidemia, metabolic syndrome or sedentary lifestyle. The study could not find a relation between smoking and low ABI. It is vital to attend all these factors to prevent and limit the atherosclerotic occurrence in the community.

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