Original Article

A Study of Peripheral Arterial Disease in Type 2 Diabetes Mellitus with Relation to Ankle Brachial Pressure Index

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Background : India shares a considerable share of the Global Disease Burden of Diabetes Mellitus which is a major public health concern. Among the many Vascular Complications of Diabetes, Peripheral Arterial Disease (PAD) is one and a major cause of Foot Related Disorders in Diabetics. The Ankle-Brachial Pressure Index (ABPI) is an efficient tool for objectively documenting the presence of lower extremity Peripheral Arterial Disease (PAD).The present study was conducted to find the prevalence of PAD in Diabetic Patients in a teaching hospital using ABPI.

Materials and Methods : A total number of 100 cases of Type 2 Diabetic patients who were more than 40 years of age were included in the study after fulfilment of the inclusion and exclusion criteria. Ankle Brachial Pressure Index was measured in all and used to assess PAD. ABPI value of ≤ 0.9 was taken as indicative of PAD.

Results : The prevalence of PAD using a ABPI Value of ≤ 0.9 was 31%. A significant association of PAD was found with duration of disease, hypertension, smoking and glycemic control.

Conclusion : Peripheral Arterial Disease (PAD) is more commonly associated with Diabetes Mellitus than is generally thought. ABPI (Ankle Brachial Pressure Index) is a simple, noninvasive and cost-effective method for early detection of PAD.

Globally, an estimated 422 million adults are living with Diabetes Mellitus, according to the latest 2016 data from the World Health Organisation (WHO)[1]. The International Diabetes Federation estimates prevalence of 8.7 percent of Diabetes in Adults in India[2]. PAD, a known complication of Diabetes Mellitus, is a manifestation of Atherosclerosis characterized by Atherosclerotic Occlusive Disease of the lower extremities and is a marker for Atherothrombotic disease in other Vascular Beds. Estimation of the prevalence of PAD in Diabetes should rely upon a validated and reproducible test. Such a test is the Ankle Brachial Index (ABI), which involves measuring the Systolic Blood Pressures in the Ankles (dorsalis pedis and posterior tibial arteries) and Arms (Brachial Artery) using a hand-held Doppler and then calculating a ratio. The Ankle-Brachial Index (ABI) is an efficient tool for objectively documenting the presence of lower extremity Peripheral Arterial Disease (PAD)[3-6]. An ABI of less than 0.90 has been shown to have a sensitivity of 90% and a specificity of 98% for detecting a lower

> **Editor's Comment :**
> - Peripheral arterial disease (PAD) is a common complication of Diabetes Mellitus.
> - ABPI is a simple, noninvasive and cost effective method to identify PAD and can help in early intervention and timely management of PAD in Diabetics to prevent its complications and associated morbidity.

extremity stenosis of greater than 50%[7,8]. This study aims to target this population and study Peripheral Arterial Disease in Diabetes with special reference to Ankle Brachial Pressure Index and Colour Doppler Sonography.

MATERIALS AND METHODS

The present study was conducted from 1st June, 2018 to May, 2019 for a period of 1 year in the department of Medicine,Silchar Medical College and Hospital, Silchar, Assam. A total of 100 type 2 Diabetic patients from the IPD (In Patient Department) were included randomly for the study, after fulfillment of inclusion and exclusion criteria. Known Type 2 Diabetics who were above the age group of 40 years and on treatment for any duration were included. Patients having history of Type 1 DM, Limb Wounds, Ulcer, Amputation, Bypass Surgery to Lower Limb Arteries, Limb Ischaemia on Cuff Inflation were excluded. Pre-tested questionnaire (proforma) were used to record information of the participants. Information on

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demography, life style and Anthropometric measurements were taken. Weight, Height, BMI (Body Mass Index) calculation by Quetelet's formula and categorization according to WHO recommendation and Blood Pressure measurement and categorization according to JNC 7 were done in all subjects. Necessary Biochemical Parameters like RBS (Random Blood Sugar), FBS (Fasting Blood Sugar), PPBS (2 hours Postprandial Blood Sugar), Hba1c (Glycosylated Hemoglobin), Lipid Parameters like Total Cholesterol (TC), Triglyceride (TG), HDL (High Density Lipoprotein) Cholesterol, LDL (Low Density Lipoprotein) Cholesterol were measured. Diabetes Mellitus was defined as per the recent American Diabetes Association (ADA) criteria. For Serum Lipid reference level, National Cholesterol Education Programme (NCEP) Adult Treatment Panel III (ATP III) Guideline was referred.The student "t" test is used to determine whether there is a statistical significance between two groups in the parameters measured. In the above test, p-value of less than 0.05 was taken as the indicator of statistical significance.

Measurement of ABPI :

All patients were subjected to measurement of ABPI by dividing the Systolic Pressure detected at a single Posterior Tibial Artery by the Systolic Brachial pressure of one arm with the patient in supine position. A hand-held portable Doppler device with a frequency of 8-10MHz and a Sphygmomanometer was used for the purpose.If the patient's ABPI was $\leq$0.9 then this indicated Peripheral Artery Disease.

$$ABI = \frac{\text{Ankle Systolic Pressure}}{\text{Brachial Systolic Pressure}}$$

RESULTS

In the study, out of 100 cases,66 (66%) no of cases were males and 34 (34%) were females.The mean age of the patients was 59.6 ± 9.94 years in the study. In the study, 11% patients had Diabetes for less than 5 years, 66 % between 5-9 years and 23% for 10 years or more. In the study,out of 100 cases the prevalence of PAD using a ABPI value of $\leq$0.9 was found to be 31%, that is out of 100 cases, 31 cases had ABPI $\leq$0.9 (either right or left leg). There were 21, 19 and 15 cases with mild PAD (ABPI 0.7-0.9) on the right side, left side and bilaterally respectively. And there were 6, 4 and 4 cases with moderate PAD (ABPI 0.41-0.69) on the right side, left side and bilaterally respectively. None of the case had ABPI <0.4 (Critical Ischaemia). Mean ABPI on the right side was 0.95±0.11 and mean

ABPI on the left side was 0.96±0.10. Out of the 31 cases with PAD (based on ABPI), 22 cases were males (70.96%)and 9 cases were females(29.03%). Mean age in cases with ABPI $\leq$0.9 was 60.32 ±10.33 years. Mean age among cases with ABPI >0.9 was 59.27 ± 9.83 years (Tables 1-3 & Fig 1).

DISCUSSION

There are numerous macro and microvascular complications associated with diabetes of which PAD is only one. The Ankle-Brachial Index is an efficient tool for objectively documenting the presence of lower extremity Peripheral Arterial Disease. The American Diabetes Association recommends measuring ABI in all diabetic patients older than 50 years or in any patient suffering from PAD symptoms or having other (Cardiovascular) risk factors.In the present study, we evaluated the prevalence of Peripheral Arterial disease using ABPI in all the Diabetic participants and also studied the correlation of various Anthropometric and other risk factors of PAD in Diabetic Patients.

In our observational study, out of 100 cases we have found that the prevalence of PAD using a ABPI value of $\leq$0.9 was 31%, that is out of 100 cases 31

Table 1 — Table showing various baseline data of study group	
Risk factors	Value (mean)
Age (years)	59.6 ± 9.94
Sex distribution	Males=66, females=34
Duration of Diabetes Mellitus (years)	7.55 ± 2.45
BMI (kg/m²)	23.40 ± 2.69
Hba1c (%)	8.264 ± 1.38
Systolic Blood Pressure (mm hg)	140.44 ±19.65
Diastolic Blood Pressure (mm hg)	85.5 ±7.94
Smoking habit	smokers=28, non smokers =72

Table 2 — Showing ABPI distribution among cases			
ABPI value	Right side	Left side	Bilateral
0.91-1.30	73	77	81
0.7-0.9	21	19	15
0.41-0.69	6	4	4
<0.4	0	0	0
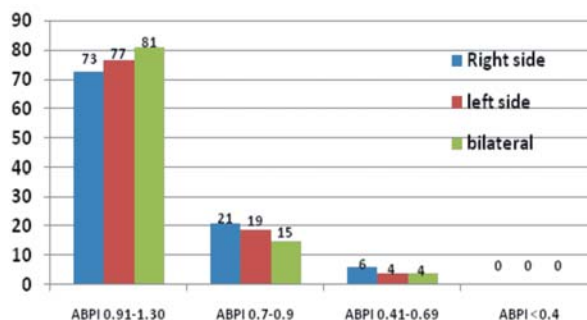
Fig 1 — Graph showing ABPI distribution among cases

Parameters	PAD (n=31)		PAD (n= 69)		P value
Male : Female	22(70.96%)/9(29.03)		44(63.76%)/25(36.23)		
Smokers/Non smokers	18(58.06%)/13(41.9%)		10(14.4%)/59(85.5%)		
	Mean	SD	Mean	SD	
Age (years)	60.32	10.33	59.27	9.83	0.31
Duration of DM (years)	8.95	2.30	6.92	2.26	<0.05
BMI (kg/m^2)	23.64	3.18	23.30	2.46	>0.05
Hba1c (%)	8.76	1.28	8.03	1.37	<0.05
Systolic Blood Pressure (mm hg)	145.87	15.78	138	20.80	0.031
Diastolic Blood Pressure (mm hg)	88.58	6.59	84.12	8.14	0.004
Total Cholesterol (mg/dl)	154.87	35.10	171.30	32.34	>0.05
LDL Cholesterol(mg/dl)	81.25	25.48	89.98	20.38	>0.05

Table 3 — *Showing comparison of different study parameters among PAD and Non PAD group*

cases had ABPI ≤0.9 (either right or left leg). Different Indian studies and studies done abroad have reported different prevalence of PAD using ankle ABPI among different population. Vinod Tyagi *et al*[9] in 2017, in their study reported a prevalence of 40% of PAD diabetics using ABPI. Similarly Vaibhav Shukla *et al*[10] in their study reported a prevalence of 36% PAD among Diabetics.

J D Solanki *et al*[11] reported a prevalence of 35% of PAD in their Study of Diabetic Patients and Marwaha *et al*[12]reported a prevalence of 33% of PAD in their study population.

In contrast A K Agarwal *et al*[13] in their study of 146 diabetic patients had found a prevalence of PAD using ABPI of 14.4% whereas Ramyashree Tummala *et al*[14] had found a prevalence as high as 57% of PAD in their study. There are studies which have shown that variability in ethnicity may be responsibe for the substantial difference in prevalence of the disease in different population.

There was no statistically significant correlation between age and presence of PAD in our study. AK Agarwal *et al*[13]and Marwaha *et al*[12] in their study found a significant association between PAD and increasing age of patient whereas in the study of Vaibhav Shukla *et al*[10] age did not emerge as a significant predictor of PAD.The prevalence of PAD was much higher among males in our study. A K Agarwal *et al*[13] , Marwaha *et al*[12], Vaibhav Shukla *et al*[10] reported a prevalence of 14.9% in males versus 13.9% in females, 62.1% in males *versus* 37.9% females and 44.4% in males versus 55.5% females respectively. We found a significant association(p value<0.05) between glycemic control and presence of PAD. Similarly A K Agarwal *et al*[13] and Marwaha *et al*[12] have also found a significant association between Inferior Glycemic Control and presence of PAD in their study. Mean duration of Diabetes in the PAD group was statistically significant when compared to individuals in the non PAD group (p

value <0.05). Similarly, Vaibhav Shukla *et al*[10], Marwaha *et al*[12] and AK Agarwal *et al*[13] all have found duration of Diabetes to be significantly higher in PAD group compared to non PAD group.

In our study we did not find a statistical significant correlation between BMI and PAD. There was a prevalence of 58.06% of smokers out of 31 cases who recorded a ABPI ≤0.9.Jayesh D Solanki *et al*[11] in their study reported that 47 % smokers recorded a ABPI <0.9. A K Agarwal *et al*[13], they found a higher prevalence of smoking in those with PAD (9.52% *versus* 1.60% in those without PAD). We found a significant correlation of PAD with both Systolic and Diastolic Blood Pressure in our study (p value <0.05). A K Agarwal *et al*[13] in their study found significant association between hypertension and PAD whereas in the study of Vaibhav Shukla *et al*[10] hypertension did not show significant association.

We did not find a significant correlation with any of the lipid parameters studied in our study.Similarly, AK Agarwal *et al*[13] in their study found no significant differences between Serum Total Cholesterol, LDL cholesterol, HDL Cholesterol or Triglyceride Levels between the PAD and the Non-PAD subgroups. Vaibhav Shukla *et al*[10] found in their study increased Lipid Levels (Total Cholesterol and LDL) were significantly associated with PAD (p value 0.036).

From our study, it was seen that there was a significant correlation of PAD (based on ABPI) with duration of Diabetes Mellitus, Glycemic Status (Hba1c), Smoking and Blood Pressure. The two tailed p value in all the cases was <0.05.

CONCLUSION

It is concluded from the present study that Peripheral Arterial Disease is more commonly associated with Diabetes Mellitus than is generally thought. ABPI is a simple, non-invasive and cost-effective method for early detection of PAD in Diabetic Patients. The prevalence of PAD is particularly high among diabetic patients in our population with the presence of more than one risk factors in most. A positive correlation of modifiable risk factors such as Smoking, Uncontrolled Blood Sugar Level, Hypertension was found with presence of PAD based on ABPI. ABPI can be used as a screening test for early detection of PAD in Diabetic Patients and help in implementing prompt treatment and prevent further

complications. However,more elaborate and extensive Multi-centered studies is desirable in this regard to precisely establish the prevalence of PAD and its correlation with risk factors.Our study had the limitation of relatively small sample size and more studies with larger sample sizes are necessary.

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