Original Article

Utility of Ankle Brachial Pressure Index as a Screening Test to Detect Peripheral Arterial Disease in Diabetes Mellitus

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ABSTRACT

Introduction: Chronic hyperglycemia in diabetic patients cause many microvascular and macrovascular changes in the body. PAD is considered to be an important macrovascular complication of diabetes mellitus, especially among those with prolonged duration of diabetes. As PAD can be asymptomatic initially, it can lead to important morbidities including amputation of limbs if not detected early. ABPI is a cheap, easy and useful tool to assess PAD even in asymptomatic diabetic patients.

Methods: This is a randomized cross-sectional study of 120 diabetic patients, asymptomatic for peripheral arterial disease, attending Medicine OPD or admitted in our tertiary care hospital of South Gujarat. Pretested proforma was used to collect data after taking informed consent. Investigations including ABPI with sphygmomanometer and colour doppler as mentioned in the proforma was carried out. Final analysis has been done with the help of Open EPI and SPSS software.

Results: 30.83 % of patients of our study population were found with abnormal ABPI. Our data shows PAD is directly associated with high HbA1c, duration of DM, and BMI. No correlation was found between age and gender. Out of 37 significant ABPI patients, 28 patients were found to have PAD by colour doppler also.

Conclusion: Among diabetic patients, high HbA1c, prolong duration of DM and high BMI were associated with abnormal ABPI, which was suggestive of PAD.

Key words: ABPI: Ankle brachial pressure index, HbA1C : Glycosylated hemoglobin, BMI : Body mass index, PAD: Peripheral artery disease.

INTRODUCTION

Diabetes is typically a multi-organ chronic disease and is associated with a ten-year-shorter life expectancy due to its complications.[1] Macrovascualr and microvascular complications are main causes of mortalities and morbidities in a diabetic patient. PAD is not only important macrovascular complication but also a predictor of underlying cardiovascular status of patient. PAD is associated with increased risk of lower extremity amputation.[2]

In many diabetics, PAD can be clinically identified by intermittent claudication or absence of peripheral pulsations in the lower extremities [3] . At the same time, it can be asymptomatic also. ABPI is an easy, non invasive and often underutilized tool for diagnosis of PAD.

This study was conducted to screen asymptomatic PAD in diabetic patients and to know its correlations with other factors. Early screening for PAD can predict underlying cardiovascular status and prevent complications associated with diabetic foot.

AIMS AND OBJECTIVES

Aim of the study is to find out the proportion of abnormal ABPI in patients of DM without symptoms of PAD. To find out the correlation of ABPI with glycemic control, duration of DM, and age of the patient, and other factors. To confirm PAD in abnormal ABPI cases using colour doppler.

METHODS

The study was done at Surat Municipal Institute of Medical Education and Research (SMIMER) Hospital, Surat, Gujarat, from year January 2019 to August 2020. It was randomized cross sectional study enrolling total 120 OPD and indoor diabetic patients without symptoms of PAD.

Patients with known case of type 2 diabetes mellitus and newly detected type 2 diabetes mellitus having FBG ≥126 mg/dl and/or 2h glucose level after oral glucose tolerance test ≥200 mg/dl and/or HbA1c ≥6.5% and/or random blood sugar ≥200 with sign and symptoms of diabetes were included in the sturdy. Patients having extreme limit of age as < 18 and > 70 years, with history of smoking, CKD, Hypertension, amputed distal limb and patient not willing to participate in the study were excluded.

Approval for this study was taken in institutional ethical committee. Informed written consent of all the participants were taken. All necessary confidentiality of participants were maintained.

Detail history, examination and investigations as per proforma were done for each participants. Variables like age, gender, BMI, Glycemic control, duration of diabetes, modality of treatment were also collected. Among glycemic

control, HbA1C >8.2 was considered as significant hyperglycemia.

ABPI was calculated as ratio of systolic blood pressure measured at ankle region (dorsalis pedis artery) and at antecubital fossa (brachial artery) for any one side of body. For this, sphygmomenometer was applied over these regions , bulb was inflated and deflated. For localization of blood flow, hand held portable doppler device with frequency of 8 to 10 MHz was used. On deflation of bulb, appearance of blood flow was taken as systolic blood pressure.

ABPI value between 1.0 to 1.4 was considered normal. Among abnormal values, ratio 0.8 to 1.0 was considered mild disease, 0.5 to 0.8 as moderate disease and <0.5 as severe disease. Value >1.4 was considered inconclusive due to non-compressible calcified artery. Value < 1.0 for any case was taken as significant for presence of PAD. Selected patients with significant ABPI were sent for Colour doppler to confirm PAD.

Data was entered in MS EXCEL spread sheet and was analyzed with the help of Open EPI and SPSS software. Statistical analysis was done by appropriate statistical method.

RESULTS

This study, conducted in a tertiary care hospital of South Gujarat, had enrolled 120 diabetic subjects without symptoms of PAD. Proportions of significant ABPI was correlated with diabetes related factors.

Table 1. Age, Sex Distribution and Duration of Diabetic patients (n=120)

Age group	Case %	Sex	Case %	Duration of DM	Case %
20-39 years	19.17	Male	58.33	<5 Years	41.67
40-59 years	45.83	Female	42.67	5-10 Years	35.00
60-70 years	35			10-15 Years	19.17
				>15 years	4.17

Table 2. Distribution of patients according to level of glycated hemoglobin (HbA1c), BMI and Modality of Treatment. (n = 120)

Level of HbA1c	Case %	Body Mass Index (BMI)	Case %	Modality of treatment	Case %
<8.2 %	34.17	<20 kg/m^2	8.33	Oral Hypoglycemic Agents (OHA)	85.83
≥8.2 %	65.83	20-25 kg/m^2	45.83	Insulin	14.16
		>25 kg/m^2	45.83		

Maximum number of patients, that is 45.83% in study group were in age group of 40-59 years, 19.17% population were in age group of 20-39 years and 35% population were in age group of 60-70 years. Mean age in the study group was 51.78 ± 11.65 (standard deviation) years. Among table patients shows that 58.33% patients were Male, 42.67% patients were Female. Maximum number of patients, that is 41.67% patients were in group of duration of diabetes <5 years, 35.00% patients were in group of duration of diabetes 5-10 years, 19.17% patients were in group of duration of diabetes 10-15 years and 4.17% patients were in group of duration of diabetes >15 years. Mean duration of diabetes in this study was 6.12 ± 4.62 (standard deviation) years.

Maximum number of patients, that is 65.83% of patients had HbA1c of ≥8.2% and 34.17% of patients had HbA1c of <8.2%. Mean HbA1c level in this study was 8.51 ± 0.98 % (standard deviation). Above table suggested that 8.33% of patients had body mass index (BMI) of <20, 45.83% of patients had body mass index (BMI) of 20 to 25 and 45.83 % of patients had body mass index (BMI) OF >25. Mean BMI in this study was 25.15 ± 4.46 kg/m2 (standard deviation). In our study, 85.83% of patients were on oral hypoglycemic agents and 14.16% of patients were on insulin treatment.

37(31%) patients out of 120 have significant ABPI while ABPI in 83(69.17%) patients out of 120 was found with insignificant.

During the study 5 patients with less than 8.2 HbA1c were found with significant ABPI.

Table 3. Distribution of Diabetic patients according to Significant ABPI (n = 120) :

Significant ABPI	No. of cases	Case %
No	83	69.17
Yes	37	30.83
Grand total	120	100

Table 4. Correlation of HbA1c with ABPI

HbA1c	Patients with insignificant ABPI (%)	Patients with significant ABPI (%)
<8.2	36 (43.37)	5 (13.51)
>8.2	47 (56.62)	32 (86.48)

Significant ABPI	Diabetic patients	Mean HbA1C % ±SD
Yes	37	9.12±0.98
No	83	8.25±0.87

P value is <0.05 with independent t test

While 36 patients with same HbA1c were found with insignificant ABPI. During the study 32 patients with more than 8.2 HbA1c were found with significant ABPI. While 47 patients with same HbA1c were found with insignificant ABPI.

During the study, longer duration of diabetes was associated with significant ABPI. 13 patients with duration of DM less than 5 years were found with significant ABPI.

Table 5. Correlation between duration of diabetes with ABPI

Duration of DM (years)	Patients with in-significant ABPI	Patients with sig-nificant ABPI
<5	37 (44.58)	13 (35.13)
5-10	34 (40.96)	8 (21.62)
10-15	9 (10.84)	14 (37.83)
>15	3 (3.61)	2 (5.4)

Significant ABPI	Diabetic patients	Mean of duration of diabetes±SD
Yes	37	7.56±5.20
No	83	5.48±4.22

P value 0.037 with independent t test

Table 6. Correlation of BMI with ABPI

BMI	Patients with insig-nificant ABPI (%)	Patients with sig-nificant ABPI (%)
<20	9 (10.84)	2 (5.4)
20-25	42 (50.6)	12 (32.43)
>25	32 (38.55)	23 (62.16)

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Significant ABPI	Diabetic patients	Mean BMI±SD
Yes	37	27.25±4.75
No	83	24.34±4.05

P value <0.05 with independent t test

Table: 7 Correlation of age with ABPI

Significant ABPI	Diabetic patients	Mean age±SD
Yes	37	55.22±10.98
No	83	50.25±11.69

P value 0.31 with independent t test

Table: 8: Correlation of gender with ABPI

Gender	Patient with insignificant ABPI	Patient with significant ABPI	Total
F	32	18	50
M	51	19	70
Total	83	37	120

P value 0.3 with Chi Square test

While 37 patients with same duration of DM were found with insignificant ABPI. 8 patients with duration of DM 5-10 years were found with significant ABPI. While 34 patients with same duration of DM were found with insignificant ABPI. 14 patients with duration of DM 10-15 years were found with significant ABPI. While 9 patients with same duration of DM were found with insignificant ABPI. 2 patients with duration of DM more than 15 years were found with significant ABPI. While 3 patients with same duration of DM were found with insignificant ABPI.

During the study 2 patients with less than 20 BMI were found with significant ABPI. While 9 patients with same BMI were found with insignificant ABPI. 12 patients with 20-25 BMI were found with significant ABPI. While 42 patients with same BMI were found with insignificant ABPI.

23 patients with more than 25 BMI were found with significant ABPI. While 32 patients with same BMI were found with insignificant ABPI.

During the study 4 patients from age group 20-39 were found with significant ABPI. While 19 patients from same age group were found with insignificant ABPI. During the study 16 patients from age group 40-59 were found with significant ABPI. While 39 patients from same age group were found with insignificant ABPI. During the study 17 patients from age group 60-70 were found with significant ABPI. While 25 patients from same age group were found with insignificant ABPI. So, correlation of ABPI with age was found insignificant.

During the study out of 50 females, 18 were found with significant ABPI while 32 were found with insignificant ABPI. During the study out of 70 males, 19 were found with significant ABPI while 51 were found with insignificant ABPI. So, correlation of ABPI with Gender was found insignificant.

Out of 120 Patient 37 patients had significant ABPI while 83 were found with insignificant ABPI. 37 patients, which were found with significant ABPI were further investigated with colour Doppler. Out of which 28 were suggestive of PAD according to colour Doppler and 9 had normal colour Doppler.

DISCUSSION

Many theories have been suggested to explain the end organ damage induced by hyperglycemia. These are, formation of advanced glycosylation end products, glucose metabolism via sorbitol pathway, activation of protein kinase C and increase influx via hexosamine pathway [4] . These processes plays the main role in causing impairments of collagen & elastin cross linkage, which thereby causes reduced elasticity of connective tissue and deposition of atheromatic plaque. These are the main basis for occurrence of PAD in diabetic patients.

It takes 10 to 15 years for macro-vascular complications to develop in a diabetic patient [5] . This pathogenic process is accelerated in diabetic patients having poor glycemic control, longer duration of diabetes and other atherogenic factors .

In present study, we screened diabetic patient without any symptoms of PAD for presence of significantly abnormal ABPI. We correlated significant ABPI with age, gender, HbA1C, duration of diabetes and BMI. In our study, prevalence of PAD by ABPI was 31 % which was comparable with other study like Marvaha et al [6] (33 %) , H B Hathila et al [7] (35 %).

In our study, 37 patients out of 120 were found with significant ABPI along with mean HbA1c of 9.12 and Std deviation 0.98. 83 patients were found of insignificant ABPI with mean HbA1c of 8.25 and Std Deviation of 0.87. P value <0.05. According to another study, Raymond Mbayo et al study [8], 39 patients out of 57 were found with significant ABPI with HbA1c more than 8.

According to Kallio and associates study [9] , 21 patients out of 83 were found with significant ABPI along with mean HbA1c of 10.3 and Std deviation 0.5. 62 patients were

found of insignificant ABPI with mean HbA1c of 9.5 and Std Deviation of 0.2.

In our study.37 patients out of 120 were found with significant ABPI along with mean duration of DM 7.56 years and Std deviation 5.2. 83 patients were found with insignificant ABPI with mean duration of DM 5.48 and Std Deviation 4.22. P value 0.03.

According to Raymond Mbayo study, 39 patients out of 57 were found with significant ABPI with duration of DM more than 10 years. According to H B Hathila study, 14 patients out of 58 were found with significant ABPI having duration of DM less than 5 years. 23 patients out of 52 were found with significant ABPI having duration of DM more than 5 years. P value 0.02.

In Our study, significant ABPI was found among 5.4% of patients with BMI <20, 32.43% of patients with BMI 20-25 and 62.16% of patients with BMI >25. According to Raymond Mbayo study, 17 patients out of 57 were found with significant ABPI with BMI more than 30.

In our study, 37 patients out of 120 were found with significant ABPI along with mean age 55.22 years and Std deviation 10.98. 83 patients were found with insignificant ABPI with age 50.25 years and Std Deviation 11.69. P value 0.31. So age had no positive correlation with abnormal ABPI. But in some other study, positive correlation was seen. According to Raymond Mbayo study, 34 patients out of 57 were found with significant ABPI with age more than 50 years.

In our study, out of 37 patients with significant ABPI, 19 are male and 18 are female. Out of total population, 70 were male and 50 were female with P value 0.3. According to Marwaha et al Study 62.1% female had significant ABPI and 37.9% male had significant ABPI with p value <0.05.

H B Hathila study suggests total 15 male out of 48 males had significant ABPI while 24 female out of 62 female had significant ABPI of p value 0.04. So according to our study, no significant correlation of gender with ABPI was found while in Marwaha et al and H B Hathila study significant correlation with ABPI was found.

CONCLUSION

Thirty one percent of patients of our study population were found with abnormal ABPI. Our data shows that, PAD is directly associated with high HbA1c, prolonged duration of DM, and higher BMI. No correlation was found between age and gender along with presence of PAD. Out of 37 significant ABPI patients, 28 patients were found to have PAD by color Doppler also. ABPI can be routinely utilized in all diabetic patients to screen for underlying PAD.

REFERENCES

1. Williams textbook of endocrinology. (12th ed.). Philadelphia: Elsevier/Saunders. pp. 1371–1435. ISBN 978-1-4377-0324-5.

2. American Diabetes Association. Peripheral arterial disease in people with diabetes. Diabetes Care. 2003;26:3333-41

3. Stratton IM, Adler AI, Neil HA. Association of glycaemia with macrovascular and micro-vascular complications of type 2 diabetes prospective observational study. BMJ. 2000; 321 (7258):405-12

4. Kasper, Braunwald, Fauci, 2004, Harrisons principles of internal medicine 17th edition vol 2, page2286-2290. edwardbetts.com/ find_link/harrison% 2527s_Principles_of _Internal_ Medicine

5. Benbassat Carlos A, Ervin Stern, Mordechai Kramer, Joseph Lebzelter, Ilana Blum, Gershon Fink. Pulmonary function in patients with Diabetes Mellitus. The Am J Med Sci 2001; 322(3):127-132. https://www.academia. edu/11999192/ vitamin B12 deficiency in type 2 diabetes patients on long term metformin_therapy_for 2 years.

6. Marwah et al, Marwaha TS,jain G,Khurana A, Dhaot PS,July 2013

7. Solanki jd, makwana ah, mehta hb, gokhle pa, shah cj, hathilla pb. assessment of ankle brachial index in diabetic patients in urban area of west india. international journal of basic and applied physiology 2012; 1:114-119

8. Raymond Mbayo : Peripheral Arterial Disease in Ugandan diabetic Patients: August 2014 / volume 9 / issue 8

9. de Courten M, Bennett PH, Tuomilehto J, Zimmet P. Epidemiology of NIDDM in Non–Europids. In: Alberti KGMM, Zimmet P, DeFronzo RA, eds. International Textbook of Diabetes Mellitus. 2nd edn. Chichester: John Wiley, 1997: pp 143–70.