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Prevalence of peripheral arterial disease in type 2 diabetes mellitus patients by ankle brachial pressure index

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Abstract: Introduction: Diabetes is growing at an exponential rate all around the world and soon is to be an epidemic in many countries including India. India topped the list of maximum reported cases of diabetes in year 2000 with 31.7 million (reported cases) it was followed by China (20.8 million) and the United States (17.7 million) in second and third place respectively. ***Material and methods*:** A Cross Sectional Study was done in the department of General Medicine at Muzaffarnagar Nagar Medical college, Muzaffarnagar, UP from September 2021 to August 2022. All type 2 diabetic patients attending the department were invited to participate in the study those fulfilling the inclusion criteria and giving consent for inclusion in the study during the period of study were enrolled in the study. A total of 200 such patients were recruited in the study. Measurement of ABPI was made in supine position after 10 minutes of rest and in a quiet room. ***Results*:** Out of 200 patients of type 2 diabetes mellitus, 72 (36.0%) were suffering from peripheral arterial disease. Prevalence of peripheral arterial disease in patients of type 2 diabetes mellitus in our institution (a teaching hospital) was 36.0%. Mean Fasting blood sugar levels of diabetic patients with PAD (187.90±100.64 mg/dl) was found to be higher than that of without PAD (182.15±74.29 mg/dl). Mean Post-prandial blood sugar (PPBS) levels of diabetic patients with PAD (280.58±121.11 mg/dl) were also found to be higher than that of without PAD (253.22±85.30 mg/dl). ***Conclusion:*** The findings of present study thus suggested that diabetic population is at a substantial risk of peripheral arterial disease and was significantly dependent on duration of diabetes, obesity (waist circumference) and presence of other comorbidities and complications like hypertension, retinopathy and neuropathy.

Keywords: Peripheral arterial disease, Type 2 diabetes mellitus, Ankle brachial pressure index.

INTRODUCTION

Diabetes is growing at an exponential rate all around the world and soon is to be an epidemic in many countries including India.[i] India topped the list of maximum reported cases of diabetes in year 2000 with 31.7 million (reported cases) it was followed by China (20.8 million) and the United States (17.7 million) in second and third place respectively. According to predictions the global prevalence of diabetes is to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India. [1] Though obesity is considered a major risk factor in diabetes and India has lower obese and overweight rates, the prevalence of diabetes in India is confounding when compared to western and European countries. [2]

Majority of people (>90%) diagnosed with diabetes in India have Type 2 diabetes (T2DM). The T2DM prevalence is more common in the elderly population in the developing countries but is affecting younger people in the developing countries like India. [3] Increase in prevalence of complications parallel to diabetes including both microvascular and macrovascular, have resulted in premature morbidity and mortality.[ii] Exposure to coronary artery disease due to dyslipidaemia and low levels of high density lipoproteins is higher in Indian population genetically; making Indians also prone to higher risks of complications concerned with diabetes and indicate development in screening and control of the disease. [4]

MATERIAL AND METHODS

These are a Cross Sectional Study was done in the department of General Medicine at Muzaffarnagar Nagar Medical college, Muzaffarnagar, UP from September 2021 to August 2022.

INCLUSION CRITERIA

Patients with diagnosis of type 2 diabetes as per WHO criteria given below:

- Symptoms of diabetes plus random blood glucose concentration more than equal to 11.1mmol/L(200mg/dl) or
- Fasting plasma glucose level more than equal to 7.0mmol/L (126 mg/dl) or
- Two hours plasma glucose more than equal to 11.1mmol/L (200 mg/dl) during an oral Glucose tolerance test or
- HbA1c more than 6.5%

Exclusion criteria

- Patients with leg ulcers
- Trauma or surgery of legs and ankle
- Lower limb filariasis
- Deep venous thrombosis
- Smokers and ex smokers
- Renal impairment

METHODOLOGY

A detailed history regarding age, sex, occupation , family history, personal habits, socio economic status, duration and treatment of diabetes was taken. Symptoms of intermittent claudication, exertional limb pain and rest pain in lower limbs was also enquired. A thorough clinical examination including examination of all peripheral pulses was done. Anthropometric measurements were recorded in all patients. Fundoscopy was done in all patients to look for retinopathy. Investigations were done noting the following parameters :

STATISTICAL TOOLS EMPLOYED

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical

1. FBS and PPBS
2. HB1AC
3. Spot micro albumin examination
4. NCV for evaluation of neuropathy

Measurement of Ankle-brachial Pressure Index[iii]

Measurement of ABPI was made in supine position after 10 minutes of rest and in a quiet room. The index is ratio of systolic blood pressure measured at the ankle to the systolic blood pressure measured at the brachial artery. A pneumatic cuff placed around the ankle was inflated to suprasystolic pressure and subsequently deflated while the onset of flow was detected with a Doppler ultrasound probe (5-10 MHz) placed over the dorsalis pedis artery and posterior tibial artery, thus denoting ankle systolic blood pressure. Brachial artery systolic pressure was assessed by routine manner with use of stethoscope to listen for the first Korotkoff sound or a Doppler probe to listen for the onset of flow during cuff deflation. Blood pressure recordings were made of the brachial pulses in the both upper limb. Similar recordings were made of the dorsalis pedis and posterior tibial pulses in the both lower limb by inflating the cuff proximal to the ankle, and the mean of these 2 readings were taken as the ankle pressure. The higher of the two values (right and left) for the lower and upper limb were taken as the systolic pressure. ABPI was calculated using the formula: ABPILeg = PLeg / Parm

Where P_{Leg} is the systolic blood pressure of dorsalis pedis or posterior tibial arteries and P_{Arm} is the highest of the left and right arm brachial systolic blood pressure.

ABPI of 0.9 or less was taken as indicative of peripheral arterial disease.

Data was recorded on a pre-designed format given below

Analysis Software. The values were represented in Number (%) and Mean±SD.

RESULTS

Table 1: Distribution according to prevalence of PAD

ABPI values	PAD Status	No. of cases	Percentage
≤0.9	Present	72	36
>0.9	Absent	128	64

Out of 200 patients of type 2 diabetes mellitus, 72 (36.0%) were suffering from peripheral arterial disease.

Prevalence of peripheral arterial disease in patients of type 2 diabetes mellitus in our institution (a teaching hospital) was 36.0%.

Table 2: Comparison of Demographic Profile, Duration of disease and Anthropometric Parameters

Parameter	PAD (n=72)		No PAD (n=128)		Statistical Significance 'p' value	
Male:Female	32 (44.4%)/ 40 (55.5%)		64 (50.0%)/ 64 (50.0%)		0.450	
	Mean	SD	Mean	SD	't'	'p'
Age (Yrs)	57.01	11.79	54.65	9.68	1.531	0.127
Duration (Yrs)	11.11	5.84	7.33	4.31	5.227	<0.001
Height (cm)	157.35	9.72	157.65	8.70	-0.225	0.822
Weight (kg)	63.31	12.78	61.16	12.66	1.148	0.252

Out of 200 diabetic patients, 104 (52.0%) were females and rest 96 (48.0%) were males. Male to female ratio in the diabetic population was 1:1.08. In patients with PAD majority were females (55.5%) and rest (44.4%) were males while in patients with no PAD proportion of males and females was equal (1:1). Difference in male:female ratio in patients diabetic patients with PAD and diabetic patients without PAD was not found to be statistically significant (p=0.450).

Difference in mean age of diabetic patients with PAD (57.01±11.79 years) and without PAD (54.65±9.68 years) was not found to be statistically significant (p=0.127).

Duration of diabetes in patients with PAD (11.11±5.84 years) was found to be statistically significantly higher than that without PAD (7.33±4.31 years).

Difference in anthropometric parameters i.e. Height, weight of patients of both the groups were not found to be significant statistically (p>0.05).

Table 3: Comparison of Fasting, Post prandial blood sugar and HbA1c between two group

Parameter	PAD (n=72)		No PAD (n=128)		Statistical Significance 'p' value	
	Mean	SD	Mean	SD	't'	'p'
Spot urine for micro albumin	440.82	144.92	410.45	195.15	1.153	0.250
FBS (mg/dl)	187.90	100.64	182.15	74.29	0.461	0.645
PPBS (mg/dl)	280.58	121.11	253.22	85.30	1.864	0.064
HbA1c (%)	7.48	1.16	7.47	1.23	0.036	0.971

Mean Fasting blood sugar levels of diabetic patients with PAD (187.90±100.64 mg/dl) was found to be higher than that of without PAD (182.15±74.29 mg/dl). Mean Post-prandial blood sugar (PPBS) levels of diabetic patients with PAD (280.58±121.11 mg/dl) were also found to be higher than that of without PAD (253.22±85.30 mg/dl). HbA1c levels of diabetic patients with PAD (7.48±1.16 mg/dl) were also found to be higher than that of without PAD (7.47±1.23 mg/dl). No significant difference was observed between two groups with respect to any of the blood sugar and glycemic control parameters (p>0.05).

Table 4: Comparison of Spot urine for micro albumin values between two group

Spot urine for micro albumin levels of diabetic patients with PAD (440.82±144.92) was found to be higher than

that without PAD (410.45±195.15) but this difference was not found to be statistically significant.

Table 4: Comparison of Spot urine formicro albumin values between two group

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Spot urine for micro albumin levels of diabetic patients with PAD (440.82±144.92) was found to be higher than that without PAD (410.45±195.15) but this difference was not found to be statistically significant.

Table 6: Correlation of ABPI with other study parameters in PAD cases (n=72)

Parameter	"r"	"p"	Interpretation
Duration of DM	-0.52	<0.001	Inverse significant moderate correlation
Height	-0.03	0.797	Weak non-significant correlation
Weight	-0.38	0.001	Inverse significant mild correlation
Waist circumference	-0.35	0.003	Inverse significant mild correlation
Hip circumference	-0.20	0.099	Inverse non-significant weak correlation
Fasting blood sugar	-0.26	0.028	Inverse non-significant weak correlation
Blood Sugar (PP)	-0.38	0.001	Inverse significant mild correlation
HbA1c	0.11	0.351	Weak non-significant correlation
S. Urea	-0.38	0.001	Inverse significant mild correlation
S. Creatinine	0.11	0.371	Weak non-significant correlation
Total Cholesterol	-0.25	0.036	Inverse non-significant weak correlation
Triglyceride	-0.43	<0.001	Inverse statistically significant

			mild correlation
LDL	0.01	0.940	Weak non-significant correlation
Spot urine for microalbumin	0.02	0.888	Weak non-significant correlation

A statistically significant inverse correlation between duration of diabetes and ABPI levels was found, strength of the correlation was found to be moderate.

An inverse correlation of ABPI levels with height, and with hip circumference was found but this correlation was not found to be statistically significant and grade of correlation was weak. Inverse and statistically significant correlation of ABPI with Weight and with Waist circumference were found and grade of correlations with weight and with waist circumference were found to be Mild. Correlation of ABPI with fasting blood sugar and with Hb1Ac were found to inverse in direction, statistically not significant and of Weak grade while correlation of ABPI with Blood sugar PP was statistically significant and inverse in direction and grade of correlation was mild. A mild and inverse correlation of ABPI with S. Urea was found which was found to be statistically significant. Correlations of ABPI with S. Creatinine, LDL levels and spot urine for micro albumin were similar in direction, of Weak grade and statistically non-significant. Correlation of ABPI with Triglyceride was inverse in direction, of Mild grade and statistically significant. Correlation of ABPI with Total cholesterol inverse in direction, of Weak grade and statistically non-significant.

7: Comparison of Symptom Status between two group

SN	**Symptom Status**	**PAD (n=72)**		**No PAD (n=128)**		**Statistical Significance 'p' value**	
		No.	%	No.	%	χ^2	'p'
1.	Symptomatic	26	100	0	0	54.13	<0.001
2.	Asymptomatic	46	26.4	128	73.6		

All the 26 symptomatic patients had PAD. However, among asymptomatic patients too, a total of 46 (26.4%) had PAD. Statistically, there was a significant association between symptomatic status and PAD (p<0.001).

Table 8: Multivariate Analysis – Linear Regression (n=200)

Independent variables	**Unstandardized Coefficients**		**Standardized Coefficients**		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	.942	.081		11.632	<0.001
Age	.000	.001	-.016	-.235	0.814
Sex (Male=1, Female=2)	.007	.010	.044	.711	0.478
Duration	-.004	.001	-.283	-3.211	0.002
Waist circumference	-.001	.001	-.206	-2.153	0.033

Hip circumference	.000	.000	.052	.545	0.586
PP Blood sugar	$-8.41x10^{-5}$	.000	-.103	-1.603	0.111
Triglyceride	$-7.16x10^{-5}$	.000	-.102	-1.640	0.103
LDL	$-2.25x10^{-5}$	.000	.009	.135	0.892
SUMA	$-1.99x10^{-5}$	.000	-.044	-.683	0.495
Hypertension (Yes=1, No=2)	-.031	.012	-.188	-2.553	0.011
TropI (Yes=1, No=2)	-.005	.013	-.027	-.406	0.685
Retinopathy (Yes=1, No=2)	.076	.015	.332	5.000	<0.001
Neuropathy (Yes=1, No=2)	.027	.013	.138	2.099	0.037

A multivariate linear regression model was proposed in which ABPI was proposed to be a dependent variable on independent variables – age, sex, duration, waist circumference, hip circumference, post-prandial blood sugar, triglyceride, LDL, SUMA, hypertension, Troponin I levels, retinopathy and neuropathy respectively. The model showed a significant negative correlation of duration, waist circumference and hypertensive status with ABPI whereas a significant positive correlation of retinopathy and neuropathy was observed with ABPI. The model had a reasonable explanatory power (r^2=0.614), thus inferring that variations in dependent variables correlated with variations in dependent variables to an estimated precision of 61.4%.

Discussion

In present study, prevalence of PAD was 36%. The prevalence of PAD among diabetic patients as observed in different studies varies substantially. Table D1 shows the prevalence of PAD in diabetic patients as observed in different studies: An overview of Table D1 above shows that prevalence of PAD among diabetics varies substantially across different studies. In present study, the prevalence of PAD was found to be 36% using ABPI<0.9 as the criteria. Using similar criteria, findings close to present study were also obtained by Solanki *et al*. (2012)[15] (35%).

In present study, we did not find a significant association of PAD with any of the glycemic control markers studied (fasting blood sugar, PP blood sugar and HbA_{1c} levels). As a matter of fact, PAD is supposed to be a long-term complication of diabetes while all these parameters are reflections of current glycemic control status. Among all these parameters, only HbA_{1c} is a parameter showing reflection of relatively longer period, however, even this parameter did not show a significant association with PAD. In our opinion, current poor glycemic control adjudged as a risk factor for PAD that has occurred retrospectively is not a justified option unless the current glycemic control is proven to be a reflection of a long-term glycemic status of patient. In present study, comorbidities like hypertension and CAD did not show a significant association with PAD, however, presence of complications like retinopathy and neuropathy were found to be significantly higher in PAD cases as compared to those not having PAD. Hypertension is a known risk factor for PAD[Error! Bookmark not defined.], some of the studies reviewed by us have also shown it to be significantly associated with PAD[16].

In present study 61.1% of PAD and 52.3% of non-PAD patients had hypertension. This widespread prevalence of hypertension in both the groups seems to have taken over the independent effect of hypertension which failed to emerge as a specific characteristic and remained a feature of generalized characteristic of study population. Association of diabetic complications such as retinopathy and neuropathy with PAD has already been documented in some studies and findings of present study substantiated these. Fowler in their study suggested sustained hyperglycemia as the common etiological factor for different micro and macrovascular complications of diabetes, the findings of present study underscored this fact. In present study, PAD was categorically defined as ABPI<0.9, however, some of the variables being analyzed, *viz*. duration of diabetes, anthropometric and biochemical measurements were continuous in nature and how does the interplay of these continuous variables with ABPI works among PAD patients, was evaluated by us by studying a linear

correlation between ABP and these parameters. In present study, evaluation of gender-specific correlation of waist and hip circumference with ABPI, for males the correlation was found to be inverse, weak and non-significant, however, among females, an inverse, moderate and significant correlation with waist circumference and an inverse mild and significant correlation with hip circumference was observed. These findings in turn indicate as to why females are at a higher risk of PAD as proposed by several previous studies. [17] In present study, on multivariate analysis, duration of diabetes, waist circumference, hypertensive status, presence of diabetic complications, *viz*. retinopathy and neuropathy were significantly associated with ABPI. Several other workers have also illustrated the multivariable model of PAD and findings of present study in consonance with the literature also underscores the multidimensional and multivariable status of PAD. [18]

Conclusion

The findings of present study thus suggested that diabetic population is at a substantial risk of peripheral arterial disease and was significantly dependent on duration of diabetes, obesity (waist circumference) and presence of other comorbidities and complications like hypertension, retinopathy and neuropathy, thus suggesting that diabetic patients with increasing duration of disease, obesity and presence of other comorbidities and complications are at a higher risk of developing PAD. These findings suggest that PAD is a problem which is multivariate in nature and hence stress on the need of regular screening of diabetic patients for peripheral arterial disease. Further studies to built more concrete evidence and to validate the results of present study are recommended in a larger population.

Referrences

1. Joshi SR, Parikh RM. India - diabetes capital of the world: now heading towards hypertension. J Assoc Physicians India. 2007;55:323–4.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes-estimates for the year 2000 and projections for 2030. Diabetes Care. 2004;27(3):1047–53.
3. Mohan V, Deepa R. Obesity and abdominal obesity in Asian Indians. Indian J Med Res2006123(5):593–96.
4. Mohan V, Anbalagan VP. Expanding role of the Madras Diabetes Research Foundation - Indian Diabetes Risk Score in clinical practice. *Indian Journal of Endocrinology and Metabolism*. 2013;17(1):31-36. doi:10.4103/2230-8210.107825. Link
5. Mohan V, Deepa R, Shanthi Rani S, Premalatha G. Prevalence of coronary artery disease and its relationship to lipids in a selected population in south India. J Am Coll Cardiol. 2001;38:682–7.
6. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. Int J Obes (Lond). 2011 Feb;35(2):167-87. doi: 10.1038/ijo.2010.135. Epub 2010 Jul 20.
7. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. Int J Obes (Lond). 2011 Feb;35(2):167-87. doi: 10.1038/ijo.2010.135. Epub 2010 Jul 20.
8. Misra A, Khurana L. Obesity-related non-communicable diseases: South Asians vs White Caucasians. Int J Obes (Lond). 2011 Feb;35(2):167-87. doi: 10.1038/ijo.2010.135. Epub 2010 Jul 20.
9. American Diabetes Association. Peripheral arterial disease in people with diabetes. Diabetes Care. 2003;26(12):3333-41.
10. Elhadd TA, Robb R, Jung RT, Stonebridge PA, Belch JJF. Pilot study of prevalence of asymptomatic peripheral arterial occlusive disease in patients with diabetes attending a hospital clinic. Practical Diabetes Int. 1999;16:163–166.
11. Marso SP, Hiatt WR. Peripheral arterial disease in patients with diabetes. J Am Coll Cardiol. 2006;47:921–929. Link
12. Hirsch AT, Criqui MH, Treat-Jacobson D, Regensteiner JG, Creager MA, Olin JW, Krook SH, Hunninghake DB, Comerota AJ, Walsh ME, et al. Peripheral arterial disease detection, awareness, and treatment in primary care. JAMA. 2001;286:1317–1324. Link.
13. Singh S, Armstrong EJ, Sherif W, Alvandi B, Westin GG, Singh GD, Amsterdam EA, Laird JR. Association of elevated fasting glucose with lower patency and increased major adverse limb events among patients with diabetes undergoing infrapopliteal balloon angioplasty. Vasc Med. 2014;19:307–314.
14 Mark A.Creager and Peter Libby Peripheral artery diseases in: Robert Bonow, Douglas Mann, Douglas Zippes, Peter Libby Editors Braunwald's Heart Disease 9th edition Elsever publishers 2012 pg 1343. Hirsch AT, Criqui MH, Treat-Jacobson D.
15 Regensteiner JG, Creager MA, Olin JW, et al. Peripheral arterial disease detection, awareness, and treatment in primary care. JAMA. 2001;286(11):1317-24.
16 Beks PJ, Mackaay AJ, De Neeling JN, De Vries H, Bouter LM, Heine RJ. Peripheral arterial disease in relation to glycaemic level in an elderly Caucasian population: the Hoorn study. Diabetol. 1995;38(1):86-96.

17 Zinman B, Gerich J, Buse JB, Lewin A, Schwartz S, Raskin P et al. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2010;33(3):692.

18 Janka HU, Standl E, Mehnert H. Peripheral vascular disease in diabetes mellitus and its relation to cardiovascular risk factors: screening with the Doppler ultrasonic technique. Diabet Care. 1980;3(2):207-13.

19 Agrawal RP, Ranka M, Beniwal R, Sharma S, Purohit VP, Kochar DK, et al. Prevalence of micro and