International Journal of Research in Medical Sciences
Sharma RK et al. Int J Res Med Sci. 2019 May;7(5):1776-1780
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20191675

Original Research Article

A study of prevalence of peripheral arterial disease in type 2 diabetes mellitus using ankle-brachial index and its correlation with coronary artery disease and its risk factors

R. K. Sharma[1], Pashaura S. Sandhu[1], Ajay Chhabra[1], Jagbir Singh[1]*, Rajat Kharbanda[2]

[1]Department of Medicine, GMC Amritsar, Punjab, India
[2]Department of Medicine, PGIMER and Dr. RML Hospital, New Delhi, India

Received: 04 December 2018
Accepted: 06 January 2019

***Correspondence:**
Dr. Jagbir Singh,
E-mail: jagbirsaini748@gmail.com

ABSTRACT

Background: Peripheral arterial disease (PAD) is one of the macrovascular complications of type 2 diabetes mellitus (T2DM). There is significant difference in the reported prevalence of PAD and its associated risk factors between Indian and Western studies. The purpose of this study was to examine the PAD complicating T2DM, in particular the influence of PAD on the risk of CAD.
Methods: Randomly selected 100 T2DM patients presented to Guru Nanak Dev hospital were included. In addition to a detailed history and physical examination, anthropometric parameters like body mass index was measured. CAD in patients was diagnosed by a history of angina, ECG changes, any past history of CAD or any treatment taken for CAD. Ankle brachial index (ABI) was measured. Data was collected systematically and analyzed according to the standard statistical methods.
Results: The prevalence of PAD was 15%. CAD was present in 31%. PAD was found to be significantly correlated with age, duration of diabetes, smoking, systolic blood pressure, diastolic blood pressure, prevalence of BMI >25 kg/m^2, HbA1c and serum HDL ≤40 mg%. Old age, high HbA1c level, and dyslipidaemia were found to be significant independent predictors of CAD.
Conclusions: Using ABI authors found evidence of PAD in 15% patients of T2DM. The prevalence of CAD was higher in patients with PAD. So, there is definite and strong correlation between PAD and CAD. Thus, the early diagnosis of PAD should alert the clinician to a high probability of underlying CAD.

Keywords: Ankle-brachial index, Coronary artery disease, Diabetes mellitus, Peripheral artery disease

INTRODUCTION

Peripheral arterial disease (PAD) is characterized by atherosclerotic occlusive disease of the lower extremities and is a marker for atherothrombotic disease in other vascular beds.[1]

In studies using the ankle-brachial index (ABI), which is the preferred screening technique, the prevalence of PAD (defined as an ABI <0.90) in diabetic individuals ranges from 20% to 30%.[2-4]

A reliable diagnosis of PAD can be made using the ankle-brachial index (ABI). This simple, painless and highly reproducible test can be performed in a physician's office and requires only a blood pressure apparatus and a hand-held, continuous-wave doppler probe.

PAD has largely been ignored especially in India. Hence, authors carried out the present study to assess the prevalence of PAD in type 2 diabetes mellitus (T2DM) by measuring ABI using a hand held doppler probe and to correlate with various risk factors. authors also sought to evaluate the relationship between PAD and CAD in those with T2DM.

METHODS

A total of 100 patients of type 2 diabetes mellitus patients who presented to department of Medicine, Government Medical College and Guru Nanak Dev Hospital, Amritsar, Punjab, India during the period of September 2017 to September 2018 were selected randomly and a cross sectional analysis was done. Each patient gave written, informed consent to participate in the study and the study protocol was approved by the Institutional ethics and thesis committee.

Inclusion criteria

- Patients with type 2 diabetes mellitus diagnosed as per American diabetes association (ADA) criteria.[5]

Exclusion criteria

- Patients with following conditions which interfered with the measurement of ankle brachial index trauma, surgery or amputation involving the limbs,
- Leg ulcers,
- Deep vein thrombosis,
- Filariasis or lower limb swelling due to other causes,
- Gestational diabetes mellitus,
- Patients on vasodilators.

A detailed history was obtained from each patient. This included age, gender, smoking, duration of diabetes mellitus, history of hypertension, family history of diabetes, history of CAD. Routine baseline investigations were performed i.e. hemogram, fasting blood glucose, 2-h post prandial blood glucose, blood urea, serum creatinine, albuminuria, electrocardiogram, HbA1C, lipid profile, ABI.

Ankle-brachial index (ABI)

ABI was calculated using hand held doppler probe and blood pressure was measured in all four limbs at brachial and posterior tibial artery/dorsalis pedis artery. ABI was calculated as ankle pressure/ brachial pressure and the lower ratio amongst the two was chosen. ABI<0.9 was diagnosed as PAD.[3]

CAD in patients was diagnosed by a history of angina, ECG changes, any past history of CAD or any treatment taken for CAD.

Statistical analysis

All the statistical analysis was done using SPSS 17.0 software. Continuous variables are expressed as the mean ±standard deviation (SD). Differences in parameters among two groups were analyzed using independent t-test. Simple descriptive statistics and chi-square test was used to estimate the association between ABI groups (ABI <0.9 and ABI>0.9); CAD and its risk factors. A binary logistic regression analysis was done to find out independent predictors of CAD. The p value <0.05 was considered statistically significant.

RESULTS

A total of 100 patients (60 men and 40 women) with type 2 diabetes were included in the study. Demographic and clinical features of these patients are shown in (Table 1).

Table 1: Demographic and clinical profile of patients in the study group.

	Men (n=60)	Women (n=40)	Total (n=100)
Age (in years) Mean±SD	60.05±7.54	60.15±6.49	60.09±7.10
Duration of diabetes (in years) Mean±SD	9.48±4.30	8.73±3.49	9.18±3.99
History of hypertension	30 (50%)	21 (52.5%)	51 (51%)
Family history of diabetes	32 (53.3%)	27 (67.5%)	59 (59%)
Smoking	15 (25%)	0 (0%)	15 (15%)

The age of the patients ranged from 40 to 80 years with a mean age of 60.09±7.10 years. The duration of diabetes ranged from 1 to 25 years with a mean of 9.18±3.99 years. More than half of the patients (51%) had history of hypertension and 15% were smokers. Family history of diabetes was present in 59%.

Mean systolic blood pressure was 135.38±9.88mmHg and mean diastolic blood pressure was 85.34±6.45mmHg. BMI ranged from 19.57 to 36.31kg/m^2 with mean BMI being 26.64±3.54 kg/m^2. Mean BMI for women (27.63±4.12 kg/m^2) was higher than for men (25.96±2.94 kg/m^2).

Mean HbA1c in the patients was 7.08±0.99%. Mean levels of FBG and PPBG were better in men than in women.

CAD as assessed by history of angina, ECG changes, any past history of CAD or any treatment taken for CAD was present in 31% (men: 28.33% and women: 35%). The prevalence of risk factors for CAD in the study group is shown in (Table 1).

Based on ABI, the prevalence of PAD was found in 15 patients out of 100 (15%) with women having a slightly higher prevalence (17.5%), as compared to men (13.3%).

The differences between the PAD and the non-PAD groups in terms of risk factors were assessed using Student's t test for continuous variables and chi square test for discrete variables. These results are summarized in (Table 2). CAD was found in 8 out of 15 PVD patients (52.33%) as compared to 23 of 85 (27.05%) non-PVD patients (p=0.043).

PAD was found to be significantly correlated with age, duration of diabetes, smoking, systolic blood pressure, diastolic blood pressure, prevalence of BMI >25 kg/m^2, HbA1c and serum HDL ≤40 mg%.

Table 2: Prevalence of cardiovascular risk factors in the study group.

Risk Factor	N
Hypertension	51
Smoking	15
F/H of DM	59
BMI>25kg/m^2	64
HbA1c>7%	51
Serum total cholesterol ≥200 mg/dl	40
Serum LDL cholesterol≥100mg/dl	42
Serum HDL cholesterol≤40 mg/dl	63
Serum triglycerides ≥150 mg/dl	25
Albuminuria >30mg/24 hours	33

Binary logistic regression (Table 3) was used to assess significant independent predictors of CAD. Old age (p=0.045), high HbA1c level (p=0.018), and dyslipidemia (total cholesterol and HDL) (p<0.05) were found to be significant predictors of CAD.

Table 3: Cardiovascular disease risk factors in PAD and Non-PAD groups.

	Non-PAD	PAD	p value
Age (in years) Mean±SD	58.66±6.24	68.07±6.55	0.000
Duration of diabetes (in years) Mean±SD	8.44±3.45	13.4±4.39	0.000
History of hypertension	41(48.2%)	10(66.7%)	0.188
Smoking	10(11.8%)	5(33.3%)	0.031
CAD	23(27.05%)	8(53.33%)	0.043
SBP (mmHg)	133.98±9.66	143.33±7.12	0.001
DBP (mmHg)	84.63±6.63	89.33±3.26	0.009
BMI (kg/m^2)	26.53±3.54	27.25±3.57	0.471
Fasting blood glucose (mg%)	143.76±44.05	145.93±35.45	0.857
Post-prandial blood glucose (mg%)	202.13±62.57	205.27±45.77	0.853
Total cholesterol (mg%)	182.33±42.29	199.06±31.25	0.147
Serum LDL (mg%)	104.47±39.22	105.53±46.69	0.925
Serum HDL (mg%)	44.06±11.26	40.1±9.63	0.200
Serum triglycerides (mg%)	132.16±59.14	133.73±45.43	0.922
HbA_{1c} (%)	6.96±0.92	7.73±1.15	0.005
Albuminuria (mg/24 hours)	57.67±245.11	75.01±193.52	0.796

DISCUSSION

In present study on 100 patients with type 2 diabetes mellitus the prevalence of PAD using ABI as detected by a hand held doppler probe was 15% (with prevalence amongst men of 13.3% and with prevalence amongst women of 17.5%),which is comparable to study conducted by Janka HU et al, in which PAD was found in 15.9%.[6] The prevalence of PAD in present study was similar to study by Agrawal RP et al, in 2000 (n=4400), Madhu SV et al, in 2006 (n=364), Kumar S et al, in 2017 (n=108) and Kumar A et al, in 2018 (n=124).[7-10] In their study, prevalence of PAD in diabetics was 18.1% and 13.73% respectively.

In studies from South India by Mohan V et al, (n=4941) and CUPS (n=1262), prevalence of PAD in diabetics was found to be 3.9% and 6.3%, respectively.[11,12] CUPS was a

community-based study not like ours which was a hospital-based study.

The Fremantle diabetes study, a community-based study, included subject with a mean age of 63.4±10.9 years and a mean duration of diabetes as 4 years in subjects without PVD. Subjects with PAD had a mean age of 70.7±13.2 years with a mean duration of diabetes of 5 years. Both variables, age and duration of diabetes, attained statistical significance (<0.05) as predictors of PAD.[13]

A study by Agrawal RP et al, found a significant correlation between age, duration of diabetes and prevalence of PAD.[14] In CUPS, a significant correlation was shown between age and PAD. In studies by Walters DP et al, and Mohan V et al, age was shown to be a significant predictor of PAD.[11,12,15]

In present study, age and duration of diabetes both were significant predictions of PAD, a finding which was similar to that of previous studies. In the PAD group, mean systolic blood pressure and mean diastolic blood pressure were significantly higher (p<0.05) as compared to the non-PAD group. With respect to hypertension our results were similar to those of The Fremantle diabetes study and CUPS.[12,13]

In present study prevalence of smoking was higher in the PAD patients (33.3%) than in the non-PAD patients (11.8%) (p=0.031). In the Fremantle diabetes study, smoking was found to be more prevalent in the PAD group than in the non-PAD group (24% vs 12.6%) and it was found to be significantly associated with PAD.[13]

In present study, mean HbA1c was 7.08±0.99%. The mean HbA1c in the non- PAD group was 6.96±0.92 mg% and mean HbA1c in the PAD group was 7.73±1.15% (p=0.005). Poor glycemic control (HbA1c >7%) was present in 47.06% in the non-PAD group compared to 73.33% in the PAD group. In present study the mean fasting, and post-prandial blood glucose levels were 144.09±42.72 mg% and 202.6±60.16 mg%, respectively. Levels of blood glucose were comparable in the PAD and the non-PAD groups. There was a significant association of HbA1c with PAD (p <0.05).

Walters et al, and Janka et al, concluded in their studies that blood sugar values were found to be significant predictors of PAD.[6,15] These studies suggest a relationship between poor glycemic control and PAD. In present study, no significant differences were found between serum triglyceride levels, serum HDL levels and serum LDL levels between the PAD and the non-PAD subgroups. In present study, serum HDL level ≤40 mg% (low HDL level) was present in 58.82% of patients without PAD as compared to 86.66% of patients with PAD (p=0.039). High LDL levels (defined as serum LDL level ≥100 mg%) was present in 40% in non-PAD group compared to 53.33% in PAD group (p=0.335). High total cholesterol levels (defined as serum cholesterol level ≥200 mg%) was found more in 53.33% patients in the PAD group compared to 37.65% patients in the non-PAD group (p=0.253) and similar results were observed in study done by Agarwal AK et al.[16] Studies by Walters DP et al, and Mohan V et al, found serum total cholesterol levels to be one of the predictive factors of PAD.[11,15]

In present study, the prevalence of CAD was 53.33% in the PAD group as compared to 27.05% in the non-PAD group (p=0.043). The odds ratio for CAD were 3.08 with a relative risk of 2.54. The results of present study with respect to the prevalence of CAD in the PAD group was similar to studies conducted by Belli B et al, (p=0.007) and Agarwal AK et al, (p=0.007).[16,17]

By using binary logistic regression analysis to assess significant independent predictors of CAD, old age (p=0.049), high HbA1c levels (p=0.02) and dyslipidaemia (high total cholesterol and low HDL level) (p <0.05) were found to be significant predictors of CAD.

CONCLUSION

The prevalence of PAD as detected using ABI in type 2 diabetics was 15%. PAD was found to be significantly correlated with age (p=0.000), duration of diabetes (p=0.000), smoking (p=0.031), systolic blood pressure (p=0.001), diastolic blood pressure (p=0.009), prevalence of BMI >25 kg/m^2 (p=0.047), HbA1c(p=0.005) and serum HDL ≤40 mg % (p=0.039). This study also showed a higher prevalence of CAD in patients with PAD, 8 out of 15 (52.33%) in the PAD group vs 23 out of 85 (27.05%) in the non-PAD group. This finding suggests that all diabetics patients diagnosed to have PAD should be carefully evaluated for CAD. However, further studies, with a larger sample size, are needed to investigate the possible mechanisms linking PAD and CAD and to determine whether PAD predicts the development and progression of CAD.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. RK Sharma, MD, Professor, Co-Supervisor, Dr. Pashaura S. Sandhu, MD, Assistant Professor, Department of Medicine, Government Medical College, Amritsar, India.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Sheehan P. Peripheral arterial disease in people with diabetes: consensus statement recommends screening. Clinic Diab. 2004;22(4):179-80.
2. Elhadd TA, Robb R, Jung RT, Stonebridge PA, Belch JJ. Pilot study of prevalence of asymptomatic peripheral arterial occlusive disease in patients with

diabetes attending a hospital clinic. Pract Diab Int. 1999;16(6):163-6.
3. Hirsch AT, Criqui MH, Treat-Jacobson D, Regensteiner JG, Creager MA, Olin JW, et al. Peripheral arterial disease detection, awareness, and treatment in primary care. JAMA. 2001;286(11):1317-24.
4. 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.
5. 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.
6. 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.
7. Agrawal RP, Ranka M, Beniwal R, Sharma S, Purohit VP, Kochar DK, et al. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Age. 2004;50:12-4.
8. Madhu SV, Kant S. Preclinical evaluation of atherosclerosis. Int J Diab Develop Countries. 2006;26(3).
9. Kumar S, Gupta A, Aswal V, Barala PD. Prevalence of asymptomatic peripheral vascular disease among type 2 diabetes mellitus patients. Int J Cur Res Rev. 2017;9(10):49-52.
10. Kumar A, Kumar A, Kumar H, Jha HK, Nayak S, Roy C. Prevalence of peripheral arterial disease & associated risk factors among type 2 diabetes mellitus patients attending diabetic health camp. Prevalence. 2018;3(2).
11. Mohan V, Premalatha G, Sastry NG. Peripheral vascular disease in non-insulin dependent diabetes mellitus in South India. Diabetes Res Clin Pract. 1995;27:235-40.
12. Premalatha G, Shanthirani S, Deepa R, Markovitz J, Mohan V. Prevalence and risk factors of peripheral vascular disease in a selected South Indian population: the Chennai urban population study. Diab Care. 2000;23(9):1295-300.
13. Norman PE, Davis WA, Bruce DG, Davis TM. Peripheral arterial disease and risk of cardiac death in type 2 diabetes: the Fremantle diabetes study. Diab Care. 2006;29(3):575-80.
14. Agrawal RP, Ranka M, Beniwal R, Sharma S, Purohit VP, Kochar DK, et al. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Age. 2004;50:12-4.
15. Walters DP, Gatling W, Mullee MA, Hill RD. The prevalence, detection, and epidemiological correlates of peripheral vascular disease: a comparison of diabetic and non-diabetic subjects in an English community. Diab Med. 1992;9(8):710-5.
16. Agarwal AK, Singh M, Arya V, Garg U, Singh VP, Jain V. Prevalence of peripheral arterial disease in type 2 diabetes mellitus and its correlation with coronary artery disease and its risk factors. J Assoc Physic India. 2012;60(7):28-32.
17. Belli B, Golabhavi N, Durgi C. Prevalence of peripheral arterial disease in type-2 diabetes mellitus and its correlation with coronary artery disease using ankle-brachial index. J Evol Med Dental Sci. 2015;4(11):1797-805.

Cite this article as: Sharma RK, Sandhu PS, Chhabra A, Singh J, Kharbanda R. A study of prevalence of peripheral arterial disease in type 2 diabetes mellitus using ankle-brachial index and its correlation with coronary artery disease and its risk factors. Int J Res Med Sci 2019;7:1776-80.