

PREVALENCE OF PERIPHERAL ARTERIAL DISEASE IN TYPE-2 DIABETES MELLITUS AND ITS CORRELATION WITH CORONARY ARTERY DISEASE USING ANKLE-BRACHIAL INDEXBasawaraj Belli¹, Naveen Golabhavi², Chetan Durgji³**HOW TO CITE THIS ARTICLE:**

Basawaraj Belli, Naveen Golabhavi, Chetan Durgji. "Prevalence of Peripheral Arterial Disease in Type-2 Diabetes Mellitus and its Correlation with Coronary Artery Disease using Ankle-Brachial Index". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 11, February 05; Page: 1797-1804, DOI: 10.14260/jemds/2015/256

ABSTRACT: OBJECTIVES: Peripheral vascular disease is one of the macrovascular complications of diabetes mellitus. The purpose of this study was to examine the peripheral arterial disease (PAD) complicating type 2 diabetes, in particular the influence of PAD on the risk of coronary artery disease.

METHODS: Randomly selected T2DM patients admitted to Basaweshwara Teaching and General Hospital were included. In addition to a detailed history and physical examination, anthropometric parameters like body mass index was measured. Relevant laboratory investigations were performed. Modified Rose questionnaire was used to diagnose coronary artery disease (CAD). Colour Doppler examination of the arteries of the lower limbs was performed. A cut off of < 0.9 was used to define peripheral arterial disease. Predictors of PAD were assessed using univariate tests of significance. Binary logistic regression was used to identify independent predictors of CAD. **RESULTS:** Out of 100 patients studied, the prevalence of PAD was 16%. CAD was present in 42%. Age, duration of diabetes, smoking, systolic and diastolic blood pressures and an HbA1c >7% were significant predictors of PAD. Older age, higher HbA1c levels microalbuminuria and deranged lipid profile were found to be significant predictors of CAD. **CONCLUSION:** We found evidence of PAD in 16% of type 2 diabetics using ankle brachial index. 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: Diabetes mellitus; Coronary artery disease; Peripheral artery disease; Ankle-brachial index.

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⁾ Peripheral arterial disease, whether symptomatic or asymptomatic, is a risk factor for non-fatal and fatal coronary disease and cerebrovascular events.⁽²⁾ Risk of death in patients of PAD within 10 years is 4 times more than those without the disease.⁽³⁾

Several studies have shown that the ankle brachial index (ABI), an index for occlusive vascular disease, is now considered an independent predictor of coronary and cerebrovascular morbidity and mortality.⁽⁴⁾ This simple, painless & highly reproducible test can be performed easily & requires only a blood pressure apparatus & hand held continuous wave Doppler probe.

Peripheral vascular disease has largely been ignored especially in India. Hence we carried out the present study to assess the prevalence of peripheral vascular disease in type 2 diabetes by measuring ankle brachial index using a Duplex Doppler ultrasound of lower limbs and to correlate

ORIGINAL ARTICLE

with various risk factors. We also sought to evaluate the relationship between PAD & coronary artery disease (CAD) in those with type 2 diabetes.

METHODS: The present study included 100 patients already taking treatment for type 2 diabetes mellitus admitted at basaveshwara teaching & general hospital, Gulbarga., Karnataka. Each patient gave written, informed consent to participate in the study. The study protocol has been approved for ethical issues also by ethics committee.

Inclusion Criteria:

1. A diagnosis of type 2 diabetes mellitus as per WHO criteria.
2. Treatment with dietary restriction and or oral hypoglycemic agents and or insulin for atleast 6 months.

Exclusion Criteria:

1. Leg trauma/fracture.
2. Leg surgery, amputation.
3. Leg ulcers.
4. Deep vein thrombosis.
5. Filariasis.
6. Lower limb swelling.

A detailed history was obtained from each patient which included age; sex; smoking; alcohol intake; diabetes-duration, treatment; hypertension-duration, treatment; family history of diabetes, CAD, hypertension, cerebrovascular diseases.

Each patient was examined for blood pressure in accordance with JNC criteria; body mass index and central obesity. (defined as waist hip ratio >0.85 in females and 0.95 in males.)

Investigations performed are resting 12-lead ECGs as per WHO recommendations; fasting and post prandial blood glucose, blood urea, serum creatinine, uric acid, HbA1c, lipid profile and micro albuminuria.

Ankle Brachial Index: With patient in supine position brachial artery systolic pressure was first measured by palpatory method and then Doppler flow method in both the arms. Similarly ankle blood pressure was taken first by palpatory method with cuff placed just above the ankle and then measuring colour Doppler blood flow in dorsalis pedis artery or posterior tibial artery of both feet. Usually 5.7 to 10 mHz probe is employed & arteries are evaluated both longitudinally & transversely by EVB700HV ultrasound machine of Hitachi. ABI < 0.9 was defined as low ABI indicative of PAD.

CAD was diagnosed by history of angina (modified ROSE questionnaire); ECG changes (Minnesota codes) or any past history of CAD or treatment given for CAD.

ORIGINAL ARTICLE

RESULTS:

	Men (n=65)	Women (n=35)	Total (100)
Age in years Mean \pm SD	58.69 \pm 11.55	56.84 \pm 10.75	57.84 \pm 11.28
Duration of diabetes(in years) Mean \pm SD	9.62 \pm 4.27	8.37 \pm 3.33	8.99 \pm 3.78
History of hypertension	29 (44.6)	12 (34.3)	41 (41)
Family history of diabetes	15 (17.9)	2 (12.5)	17 (17)
Smoking	22 (33.8)	0 (0)	22 (22)

Table 1

A total of 100 (65 men and 35 women) patients with type 2 diabetes were included in the study.

The age of the patients ranged from 31 to 95 years with a mean age of 57.84 years. The duration of diabetes ranged from 1 to 25 years with a mean of 8.99 years. About 41% were hypertensive and significant people (22%) were smoked.

CAD, as assessed by the Rose questionnaire and Minnesota code, was present in 42 percent of the patients with men having a prevalence (49.2%) comparable to women (28.6%).

	Non-PVD	PVD
	Total (n=84)	Total (n=16)
Fasting blood glucose (FBG)	141.31 \pm 45.14	126.75 \pm 21.39
2 hours post-prandial blood glucose (PPBG)	198.0 \pm 60.49	186.5 \pm 59.58
Blood urea	32.46 \pm 10.84	33.44 \pm 16.46
Serum creatinine	1.01 \pm 0.28	1.01 \pm 0.36
Serum uric acid	5.60 \pm 1.68	5.32 \pm 1.54
Serum total cholesterol	174.84 \pm 41.27	213.56 \pm 33.50
Serum LDL	108.10 \pm 45.44	110.81 \pm 44.99
Serum HDL	47.42 \pm 17.87	43.25 \pm 10.18
Serum triglycerides	133.61 \pm 66.94	140.06 \pm 51.13
HbA _{1c} (%)	6.76 \pm 0.68	7.00 \pm 0.91
Urinary microalbuminuria/ albuminuria (mg/24 hrs)	67.73 \pm 253.80	23.53 \pm 19.21

Table-2: Comparison of biochemical parameter between groups

Note: All values are expressed as Mean \pm S.D. All values except HbA_{1c} and albuminuria are in mg/dl.

ORIGINAL ARTICLE

The mean systolic blood pressure was 135.9 mm Hg and mean diastolic blood pressure was 86.5 mm Hg. BMI ranged from 16-37 kg/m² with mean BMI being 26.39 Kg/m². Mean BMI for women (27.64 kg/m²) was higher than for men (25.72 kg/m²) (table 2).

Most patients had fairly good blood glucose control (mean HbA1c 7.00 mg%). However, diabetic control as measured by FBG, PPBG and HbA1C was better in men than in women.

Doppler examination of all four limbs was performed in all patients and their ABI was calculated. Patients were divided into two subgroups,

- 1) PVD (Peripheral Vascular Disease) - ABI <0.9 or abnormal waveform
- 2) Non-PVD - ABI > 0.9

Prevalence of PVD in the study group was 14% with women having a slightly higher prevalence (16.9%), as compared to men (14.3%).

Out of PVD group 3 patients were symptomatic. The most common symptom was intermittent claudication which was present in all symptomatic patients. On clinical examination 5 patients had decreased peripheral pulses. However, none of patients had ulcer, gangrene, skin changes and dependent pallor.

The mean age, duration of diabetes and hypertension were higher in the PVD group than in the non-PVD group. Dyslipidaemic and glucose intolerant patients had PVD more often.

CAD was found more often in the PVD group (81.3%) as compared to the non- PVD group (34.5%).

In comparison to Non-PVD group, patients with PVD had a higher prevalence of HTN, smoking, obesity, & higher HbA1C. Lipid profile abnormalities were common in PVD group than in Non-PVD group.

Age, duration of diabetes, smoking, SBP, DBP and HbA1C were found to be significantly different between the two groups (p<.05).

DISCUSSION: Diabetes affects nearly every vascular bed. Patients with diabetes mellitus suffer from high incidence of premature and severe atherosclerosis^(5,6,7) The Framingham study pointed out the cause of the much higher incidence of cardiovascular complications in diabetic patients. These individuals have a much higher serum concentration of lipids and a higher occurrence of obesity leading to advanced atherosclerosis.⁽⁵⁾ Peripheral vascular disease (PVD) is a manifestation of atherosclerosis characterized by atherosclerotic occlusive disease of the lower extremities.⁽⁸⁾

The present study is a observational study performed on 100 type 2 diabetic patients (65 men and 35 women) admitted in Basaveshwara Hospital. The subjects were screened for peripheral vascular disease by subjecting them to Doppler ultrasound for the presence of PVD on the basis of which the study group was divided into two viz.. patients having PVD and patients not having PVD.

Risk factor	Non PAD	PAD	P value
Age (years) Mean +SD	57.25 ± 11.65	60.94 ± 8.77	0.233
Duration of diabetes (years) Mean +SD	8.55 ± 3.51	12.50 ± 4.82	0.001
Hypertension	30 (37.7)	6 (37.5)	0.006
Smoking	15 (17.9)	7 (4.8)	0.059

ORIGINAL ARTICLE

CAD	29 (34.5)	13 (81.3)	0.006
SBP (mmHg)	134.62 ±10.28	144.10 ± 9.60	0.001
DBP (mmHg)	86.10 ± 0.46	89.52 ± 5.27	0.005
BMI (Kg/m ²)	26.5 ±3.78	25.83 ±3.41	0.875
Fasting blood glucose (mg%)	141.31 ± 45.14	126.75 ± 21.39	0.833
Post-prandial blood glucose (mg%)	198.0 ± 60.49	186.5 ± 59.58	0.748
HbA1C (%)	6.76 ± 0.68	7.0 ± 0.91	0.001
Total cholesterol (mg%)	174.74 ± 41.27	213.56 ± 33.50	0.002
Serum LDL (mg%)	108.10 ± 45.44	110.81 ± 44.99	0.471
Serum HDL (mg%)	47.42 ± 17.87	43.25 ± 10.18	0.001
Serum triglycerides (mg%)	133.61 ± 66.94	140.06 ± 51.13	0.607
Urinary microalbuminuria/albuminuria mg / 24 hrs.	67.73 ± 253.80	23.53 ± 19.21	0.568

In the present study, the mean age of the subjects was 57.84 ±11.28 years (men- 58.69±11.55 years and women - 56.84 ±10.75 years). The mean duration of diabetes was 8.99±3.78 years (men - 9.62±4.27 years and women - 8.37±3.33 years). The group under study had 22% subjects who were smokers, 17% who gave a positive family history of diabetes and 41% of patients were hypertensive.

A mean BMI was 26.39±3.72 Kg /m² (26.50±3.78 of men and 25.83±3.41 of women). Poor glycaemic control (HbA1c >7%) was present in 43% of patients. 32% had hypertriglyceridaemia (>150 mg/dl) and 58 % had low HDL levels (<40mg/dl). Microalbuminuria was found in 25 % of patients.

The prevalence of PVD as detected by Doppler ultrasound (ABI) was 16 % (men- 16.9% and women- 14.3%) which is comparable with the prevalence found in previous studies.

Studies by Walters et al¹³ in 1992, Migdalis et al¹⁴ in 1992 and the Fremantle diabetes study in 2005 by Paul et al⁹ showed a PVD prevalence of 23.5%, 44% and 13.6%, respectively. Two large studies from South India, namely by Mohan et al¹⁰ in 1995 (n=4941) and CUPS ⁽¹¹⁾ in 2000 (n=1262) found a prevalence of PVD in diabetics of 3.9% and 6.3% respectively. CUPS was a community based study unlike ours which was hospital based.

Recently Agrawal et al¹² in 2000 (n=4400) and Madhu et al¹³ in 2006 (n=364) found prevalence of PVD in diabetics to be 18.1% and 13.73% respectively. These two studies were performed in North India.

In our study, the mean age was 57.84±11.28 years (men- 58.69±11.55 years and women - 56.84±10.75 years) and mean duration of diabetes was 8.99±3.78 years (men- 9.62±4.27 years and women- 8.37±3.33 years). Both age and duration of diabetes were significant predictors of PVD, a finding similar to that of previous studies. Family history of diabetes was not a significant predictor of PVD.

ORIGINAL ARTICLE

In our study there was no correlation found between obesity and PVD. Our results along with those of other Indian studies like CUPS⁽¹¹⁾ and the study by Agrawal et al,⁽¹²⁾ suggest that unlike in Western populations, obesity does not appear to be a significant risk factor for PVD in Indian diabetics.

In our study, no significant differences were found between serum triglyceride levels, HDL levels, total cholesterol and serum LDL levels between the PVD and the non-PVD subgroups.

Walters et al⁽¹⁴⁾ and Mohan et al⁽¹⁵⁾ found serum total cholesterol levels to be one of the predictive factors for PVD.

Our study showed a higher prevalence of smoking in PVD patients than in non-PVD patients (43.8% vs 17.9%). However, the overall prevalence of smoking is moderate (22%).

In our study there was no significant difference in the prevalence of microalbuminuria between patients with and without PVD.

The prevalence of CAD was 81.3% in PVD patients and 34.5% in non-PVD patients. This difference was statistically significant ($p=0.007$). The Fremantle diabetes study⁽¹⁶⁾ was a prospective study to assess the association between PVD and CAD. This study found that a low ABI was associated with a 67% increase in the risk of cardiac death.

In the CUPS study,⁽¹¹⁾ the prevalence of CAD was not found to be significantly higher in the PVD group as compared to the non-PVD group. However, a similar study from South India by Krishaswamy et al⁽¹⁷⁾ showed that PVD was common in elderly people with coronary artery disease.

We used binary logistic regression to assess significant independent predictors of CAD. Older age ($p=0.01$), higher HbA1c levels ($p=0.02$), waist-hip ratio ($p=.05$), microalbuminuria ($p=0.03$) and deranged lipid profile (high total cholesterol, and triglyceride levels as well as low HDL levels) were found to be significant predictors of CAD. A higher incidence of CAD has been shown in patients with PVD by several studies. However CUPS study,⁽¹¹⁾ a cross-sectional study from South India, failed to find a correlation between CAD and PVD.

CONCLUSION: According to our results, PVD was present in 16% of type 2 diabetics, with comparable prevalence of 16.9% and 14.3% in men and women, respectively.

Risk factors significantly associated with PVD were age, duration of diabetes, systolic and diastolic blood pressure, smoking, HbA1C, high total cholesterol low HDL and CAD.

This study also showed a higher prevalence of CAD in patients with PVD, 13 out of 16 (81.3%) in the PVD group vs 29 out of 84 (34.5%) in the non-PVD group.

A significant correlation was found for age, smoking, HbA1C, total cholesterol, low HDL, triglyceride levels and microalbuminuria.

Despite its prevalence and association with cardiovascular disease, PAD is still underdiagnosed and undertreated. It has been shown that medical therapy approved for CVS is effective in treatment of PAD and decreases cardiovascular events.

However, further studies, with a larger sample size, are needed to investigate the possible mechanisms linking PVD and CAD and to determine whether PVD predicts the development and progression of CAD.

REFERENCES:

1. Sheehan P. Peripheral arterial disease in people with diabetes. *Clin Diabetes* 2004; 22: 179-189
2. Norman PE, Eikelboom JW, Hankey GJ. Peripheral arterial disease – prognostic significance and prevention of atherothrombotic complications. *MJA* 2004; 181: 150–4.
3. Brevetti G, Oliva G, Silvestro A, Francesco S, Chiariello M. Prevalence, risk factors and cardiovascular comorbidity of symptomatic peripheral arterial disease in Italy. *Atherosclerosis* 2004; 175: 131–8.
4. Hertzler NR. The natural history of peripheral vascular disease –implications for its management. *Circulation* 1991; 83(Suppl 1): 9–12.
5. Gorcia MJ, McNamara PM, Gordon T, et al. Morbidity and mortality in diabetics in the Framingham population : Sixteen year follow up study. *Diabetes* 1974; 23: 105-11.
6. Santen RJ, Willis PW III, Fajans SS. Atherosclerosis in diabetes mellitus: correlation with serum lipid levels, adiposity and serum insulin level. *Arch Intern Med* 1972; 130: 833-43.
7. Chan A, Beach AW, Martin DC, et al. Carotid artery disease in non insulin dependent diabetes mellitus. *Diabetes Care* 1983; 6: 562-69.
8. Sheehan P. Peripheral arterial disease in people with diabetes. *Clin Diabetes* 2004; 22: 179-189.
9. Premalatha G, Shanthirani S, Deepa R, et al. Prevalence and risk factors of peripheral vascular disease in a selected South Indian population: the Chennai Urban Population Study. (CUPS) *Diabetes Care*. 2000; 23: 1295-300.
10. Mohan V, Premalatha G, Sastry NG. Peripheral vascular disease in noninsulin dependant diabetes mellitus in South India. *Diabetes Res Clin Pract* 1995; 27: 235-40.
11. Janka HU, Standi E, and Mehnert H Peripheral vascular disease in diabetes mellitus and its relation to cardiovascular risk factors screening with Doppler. *Diabetes Care*.1980; 3: 207.
12. Krishnaswamy B, Raja N, Deepa S A study of peripheral vascular disease in elderly and its association with coronary artery disease: *J Indian Acad Geriatrics*, 2006; 2: 10-13.
13. Madhu SV, Kant S. Preclinical evaluation of atherosclerosis. *Int j Diabetes dev Ctries* 2006; 26: 105-11.
14. Walter DP, Gatting W, Mullee MA, et al. The prevalence of diabetics and non-diabetic subjects in an English community. *Diab Medicine* 1992; 9: 710-15.
15. Mohan V, Premalatha G, Sastry NG. Peripheral vascular disease in noninsulin dependant diabetes mellitus in South India. *Diabetes Res Clin Pract* 1995; 27: 235-40.
16. Peripheral arterial disease and risk of cardiac death in type 2 diabetes. *Diabetes care* 2006; 29: 575-80.
17. Leng GC, Lee AJ, Fowkes GR et al. Incidence, natural history and cardiovascular events in symptomatic and asymptomatic peripheral arterial disease in the general population. *Int J Epidemiol* 1996; 25: 1172-1181.

ORIGINAL ARTICLE

AUTHORS:

1. Basawaraj Belli
2. Naveen Golabhavi
3. Chetan Durgi

PARTICULARS OF CONTRIBUTORS:

1. Professor, Department of General Medicine, MRMC, Gulbarga.
2. Post Graduate, Department of General Medicine, MRMC, Gulbarga.
3. Professor and Head, Department of Radiodiagnosis, MRMC, Gulbarga.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Naveen Golabhavi,
White House,
CPM School Campus,
Near Basaveshwara Hospital,
Sedam Road, Gulbarga – 585105.
E-mail: drnaveengolabhavi@gmail.com

Date of Submission: 22/01/2015.
Date of Peer Review: 23/01/2015.
Date of Acceptance: 29/01/2015.
Date of Publishing: 03/02/2015.