

Evaluation of Prevalence and Pattern of Lower Limb Arterial Insufficiency Among Patients with Diabetes Mellitus Using Color Doppler Flow Imaging

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ABSTRACT

Introduction: Diabetes Mellitus is one of the most common pathologies, especially in developing countries. In India, the burden of diabetes has been increasing steadily since 1990 and has leapt at a faster pace since the year 2000. Over years, Diabetes leads to many macrovascular and microvascular complications. Color Doppler is an easily available and affordable, noninvasive investigation to assess arterial insufficiency. The aim of the present study was to evaluate prevalence and pattern of lower limb arterial insufficiency among patients with diabetes mellitus using Color Doppler.

Aim: To evaluate prevalence and pattern of lower limb arterial insufficiency among patients with diabetes mellitus using Color Doppler.

Material and Methodology: This observational cross-sectional study was conducted on 133 diabetic patients attending medicine outpatient department (OPD) and patients admitted in medicine ward (IPD) of Govt. Medical College and Rajindra hospital, Patiala.

Results: Most of the patients were in age group 51-60 years. In majority of patients, diabetes was present for 11-15 years, followed by 6-7 years. In our study, 35.3% (n=47) patients had evidence of peripheral arterial insufficiency on color doppler. Out of all the patients with arterial insufficiency, 57.40% of patients had hypertension as comorbidity. The prevalence of

arterial insufficiency was more in patients with coexistent hypertension and diabetes mellitus. The most commonly affected artery was dorsal pedis artery (9.8%).

Conclusion: In patients with clinical suspicion of peripheral vascular disease duplex sonography can provide as the initial/first imaging modality of investigation. Forty seven patients (35.3%) had evidence of peripheral arterial insufficiency in diabetic patients in our study.

Keywords: Peripheral artery disease, Prevalence, Lower Limb, Diabetes Mellitus, Color Doppler Flow Imaging.

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INTRODUCTION

Peripheral artery disease (PAD) is defined as an atherosclerotic occlusive disease of upper and the lower extremities. As per some previous studies, co-morbid PVD or PAD is present in 9.5% of patients ≥ 40 years old with diabetes mellitus and the risk of developing PVD is up to 20 times higher in patients with diabetes mellitus.^[1] The patients can present with the classic symptom of leg pain which usually relieves by taking rest called intermittent claudication.^[2] Because of the high number of patients presenting directly with complications of PAD, it is crucial to assess the condition of the lower limb's peripheral arteries in terms of any stenosis (%) and its relationship to the patient's symptomatology.^[3] In this study, we have defined peripheral arterial disease as patients with atherosclerotic plaque and /or stenosis of any grade on doppler sonography. Techniques used in the diagnosis of lower

limb arteries occlusion are pulse measurements, ankle-brachial index (ABI), Doppler flow imaging, and CT-angiography.

Doppler sonography is better than CT angiography in the diagnosis of early onset cases because it gives a better assessment of soft plaque, segmental flow and recanalization in peripheral arterial disease.

MATERIALS AND METHODS

This observational cross-sectional study was conducted on diabetic patients attending medicine outpatient department (OPD) and patients admitted in medicine ward (IPD) of Govt. Medical College and Rajindra hospital, Patiala. All the patients who were known case of diabetes mellitus with age more than 18 years were included in the study. Patients who were pregnant or

patients with previous h/o trauma to arterial vasculature or h/o diabetic foot amputation were excluded from the study. One hundred thirty-three patients were included in the study.

Statistical analysis

Sample Size calculation: Formula for calculating sample size: $n = N \times X / (X + N - 1)$, where, $X = Z_{\alpha/2}^2 \times p \times (1-p) / MOE^2$, and $Z_{\alpha/2}$ is the critical value of the Normal distribution at $\alpha/2$ (e.g., for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size.

$N=10950$ $p=3\%$ $MOE=5\%$ So, $n=130$

To reduce the margin of error sample size is taken as 133

The data was collected and compiled in MS excel and all the data was analyzed in SPSS version 26. Frequency of all the variable was calculated. For analysis of categorical data Chi square test was used and for grouped data t-test was used for the analysis. The p value of ≤ 0.05 was considered to be significant.

RESULTS

Majority of patients, 32.3% were present in age group 51- 60 years ($n=43$) followed by 25.6% in age group of 61-70 years ($n=34$) and 23.3% in age group of 41-50 years ($n= 31$).

The mean age of the patients was 57.96 years. In our study, 85(63.9%) of patients were males while 48(36.1%) were females.

Pain was present in 43(32.3%) patients, 53(39.8%) patients complained of numbness and claudication was present in 52 (39.1%) patients. In the majority ($n=65$) of patients (48.9%)

diabetes was present for 11-15 years, followed by 6-10 years in 47 patients (35.3%), <5 years in 18 patients (13.5%) and in 3 patients (2.3%) the duration was >15 years.

Atherosclerotic plaque was present in 47(35.3%) patients while it was absent in 86(64.7%) patients. The most commonly affected artery was dorsal pedis artery alone in 13 patients (9.8%), followed by posterior tibial artery with dorsalis pedis artery in 13 patients (9.8%).{Table1}

Biphasic spectral waveform was found in 23 (17.3%) patients. Monophasic and patchy monophasic spectral waveform was found in 13 (9.8%) and 11(8.3%) patients respectively. Rest 86 (64.5%) had triphasic spectral waveform {Table 2}.

Among the patients with no arterial insufficiency, 14 patients (16.30%) had hypertension and 72 patients (83.70%) did not have hypertension. Among the patients with arterial insufficiency, 27 (57.40%) had hypertension and 20 (42.60%) did not have hypertension. Thus, the prevalence of arterial insufficiency was more in patients with coexistent hypertension (P-value<0.001) {Table3} Among males, 33 patients (70.20%) had arterial insufficiency. Among females, 14 patients (29.80%) had arterial insufficiency. No significant association was seen between lower limb insufficiency and gender. (p-value-0.263).

It was observed that significantly more claudication (91.50% vs 10.50%), pain (42.60% vs 26.70%) and numbness (44.70% vs 37.20%) were present in patients with arterial insufficiency than patients with no arterial insufficiency. However, association with pain and numbness was not significant. {table 4}

Table 1: Distribution of Patients According To Affected Artery

Affected artery	Frequency	Percent
Normal	86	64.7
Dorsalis pedis alone	13	9.8
Posterior tibial with dorsalis pedis artery	13	9.8
Popliteal artery and distal arterial branches	8	6
Superficial femoral and distal femoral	5	3.8
Anterior and Posterior tibial with dorsalis pedis artery	4	3
Posterior tibial artery alone	2	1.5
Popliteal artery alone	1	0.8
Common femoral artery	1	0.8
Total	133	100

Table 2: Distribution of Patients According To Pattern of Spectral Waveform of Blood flow

Pattern of spectral waveform	Frequency	Percent
Monophasic	13	9.8
Biphasic	23	17.3
Triphasic	86	64.7
Patchy Monophasic	11	8.3

Table 3: Association of PAD with Hypertension

Medical history		Lower Limb Arterial Insufficiency						p-value
		Absent		Present		Total		
		n	%	n	%	N	%	
Hypertension	Absent	72	83.70%	20	42.60%	92	69.20%	<0.001
	Present	14	16.30%	27	57.40%	41	30.80%	
	Total	86	100.00%	47	100.00%	133	100.00%	

Table 4: Association of Lower Limb Arterial Insufficiency and Chief Complaints

Chief complaints	Lower Limb Arterial Insufficiency						p value
	Absent		Present		Total		
	n	%	n	%	n	%	
Pain	23	26.70%	20	42.60%	43	32.30%	.06
Numbness	32	37.20%	21	44.70%	53	39.80%	.4
Claudication	9	10.50%	43	91.50%	52	39.10%	<0.001

Table 5: Comparison of Grouped Variables in Patients with and without Lower Limb Arterial Insufficiency

Variables	Lower Limb Arterial Insufficiency				t- value	p value
	Present (n=47)		Absent (n=86)			
	Mean	SD	Mean	SD		
Age(years)	59.70	11.03	57.01	11.49	1.31	0.193
Duration of diabetes(years)	12.96	3.13	8.40	3.74	7.11	<0.001
Systolic BP (mm hg)	131.43	19.67	128.35	11.04	1.16	0.249
Diastolic BP (mm hg)	89.85	9.02	84.28	9.94	3.19	0.002
BMI (kg/m2)	25.70	3.01	24.78	2.86	1.75	0.083
Haemoglobin(gm/dL)	12.36	1.82	12.31	1.71	0.15	0.88
Fasting blood sugar (mg/dL)	200.81	35.24	198.20	35.17	0.41	0.683
Total cholesterol(mg/dL)	196.72	18.38	196.16	18.26	0.17	0.864
LDL (mg/dL)	122.53	16.66	121.45	17.61	0.34	0.731
TGL (mg/dL)	135.43	33.14	138.86	33.90	-0.56	0.574
HDL (mg/dL)	47.11	3.67	46.93	3.49	0.27	0.785
Glycated haemoglobin levels (HbA1C %):	8.11	1.17	7.65	1.09	-2.23	0.028
Blood Urea(mg/dl)	28.77	3.18	27.64	2.79	2.04	0.043
Serum Creatinine (mg/dl)	0.97	0.21	1.00	0.22	-0.89	0.373

DISCUSSION

Peripheral arterial disease (PAD) is a chronic disease and is an independent predictor of cardiovascular and cerebrovascular disease. Despite the fact that PAD is associated with a marked increase in the risk of ischemic events, it is largely underdiagnosed and undertreated. The risk of PAD is markedly increased among individuals with diabetes, and ischemic event rates are higher in diabetic individuals with PAD as compared to non-diabetic populations. Consequently, early diagnosis and treatment of PAD in patients with diabetes is critically important to reduce the risk of cardiovascular events, minimize the risk of long-term disability, and improve quality of life.

The prevalence of lower limb arterial insufficiency among patients with Diabetes mellitus was found to be 35.3% (n=47) patients. 85(63.9%) of patients were males while 48(36.1%) were females. No significant association was seen between lower limb arterial insufficiency and gender. In our study, males (33/85=38.8%) had a more percentage of PAD than females (14/48=29%).

In a study by Mondal et al.^[5] the ratio of male and female (Male: Female) was 1.5:1.0. Pain was present in 43(32.3%) patients, 53(39.8%) patients complained of numbness and claudication was present in 52(39.1%) patients. Previous studies have observed different incidences of claudication in diabetics (62% in the study by Sohail et al.^[6] vs 20.5% in the study by Ismail et al.^[7]).

Patients in whom lower limb arterial insufficiency was present presented with significantly more claudication (91.50% vs 10.50%), pain (42.60% vs 26.70%) and numbness (44.70% vs 37.20%) was significantly more in cases with lower limb insufficiency. However, association with pain and numbness was not found to be significant.

The mean duration of diabetes in patients with insufficiency was 12.96 ± 3.13 while with no insufficiency it was 8.40 ± 3.74 . ($p < 0.001$). Similar results were noted in previous study conducted by Mondal et al.^[5] History of hypertension was present in 41(30.8%) patients. The prevalence of arterial insufficiency was more in patients with coexistent hypertension and T2DM. The levels of glycated Hb levels were significantly more in patients with lower limb insufficiency (8.11 ± 1.17 % vs 7.65 ± 1.09 %) ($p = .028$).

Similar results were noted in the study by Mondal et al.^[5] who showed that the mean HbA1c in the PAD category was 7.25 ± 0.80 % ($P < 0.001$), which was significantly higher than in the non-PAD category (mean HbA1c 6.50 ± 0.27 %).

The most commonly affected artery was dorsal pedis alone in 13 patients (9.8%), followed by Posterior tibial with dorsalis pedis artery (DPA) in 13 patients (9.8%). Hameed et al.^[8] in the study observed that DPA was the most commonly involved artery with significant stenosis (26%) followed by the femoral artery (18%).

Mild stenosis was seen in 21 patients (15.8%), moderate in 20 patients (15%) and severe stenosis was seen in 6 patients (4.5%). We observed biphasic waveform in 23(17.3%), triphasic in 86(64.5%), monophasic and patchy monophasic were observed in 13(9.8%) and 11(8.3%) respectively. Biphasic flow spectrum was most common in the dorsalis pedis artery in present study.

In a study by Seth et al.^[9] normal arterial blood flow with triphasic pattern of spectral waveform was observed more in proximal vessels i.e., maximum being in common femoral artery (78.46%) and decreasing towards the infrapopliteal vessels, the least being in dorsalis pedis (29.23%). Biphasic and monophasic flow became prominent in infrapopliteal vessels with biphasic flow becoming the predominate pattern in posterior tibial artery and dorsalis pedis artery.

Limitations of this study were lack of medical records for verification of the duration of diabetes and lack of data pertaining glycemic control.

SUMMARY AND CONCLUSION

From the study it appears that significant number of patients with Diabetes Mellitus have peripheral arterial disease and if not diagnosed timely, can lead to a variety of complications like diabetic foot, non-healing ulcers, lifelong disability and sepsis which can be life threatening. In this study, 47 (35.3%) patients had evidence of peripheral arterial insufficiency on duplex ultrasonography. Dorsalis pedis artery and posterior tibial artery were the most common arteries involved. In patients with clinical suspicion of peripheral vascular disease, duplex sonography can serve as the initial imaging modality of investigation being cheap, easily available and non-invasive. Considering the large burden of the disease in our country (Diabetic capital of the world), it is of utmost importance to recognize the symptoms and to implement therapeutic interventions at the earliest.

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