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PREVALENCE OF PERIPHERAL VASCULAR DISEASE IN PATIENTS PRESENTING WITH DIABETIC FOOT ULCERS IN GENERAL OUTPATIENT SETTING OF CMH / PEMH RAWALPINDI: A CROSS-SECTIONAL STUDY

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Abstract

Objective: *To assess the frequency of peripheral vascular disease, and its determinants in diabetic foot ulcers*

Methodology: *This cross-sectional study was conducted at Combined Military Hospital Rawalpindi, from January to December 2024. Type 2 diabetes mellitus patients aged 18 years or older presenting with foot ulcers were included in the study. The data were collected on basic demographic characteristics and clinical parameters. The Ankle Brachial Index was used to establish peripheral vascular disease (arterial). The primary variable was frequency of peripheral vascular disease. The data was analysed using SPSS version 25.0*

Results: *This study included n=264 patients with a median age of 60.00 (46.00-68.00) years. There were 170 (64.39%) males and 94 (35.61%) females. Only 57 (21.59%) patients had peripheral vascular disease. A significantly higher proportion of females was observed in the peripheral vascular disease group (50.9% vs. 31.4%; p = 0.007). Glycaemic control was significantly poorer among patients with peripheral vascular disease (p < 0.001), median total cholesterol was higher (4.60 vs. 2.90 mg/dL; p < 0.001) and median serum triglyceride levels were also elevated (3.80 vs. 2.90 mg/dL; p < 0.001). Additionally, hypertension and coronary artery disease was more common in the peripheral vascular disease group (p < 0.001 and p=0.012).*

Conclusion: *The peripheral vascular disease is more frequent (21.59%) complication in diabetic foot ulcers and is associated with dyslipidaemia, metabolic diseases and female gender.*

INTRODUCTION

Diabetic foot ulcers (DFU), also referred to as Diabetic foot, are a well-documented complication of poorly controlled diabetes mellitus, which can be unliteral but usually it is bilateral due to the systemic nature of the disease. Usually, the underlying culprit is

peripheral arterial disease (estimated between 19-34%) and neuropathy, which occur due to insults caused by raised blood glucose levels, dyslipidaemia, impaired blood flow, and atherosclerosis.[1, 2] The risk of DFU is as high as 25% and most of the patients would require admission for management, however it is avoidable complication with current evidence based management strategies.[3, 4] Keeping this view, International Working Group on the Diabetic Foot (IWGDF) recommends annual foot review in the absence of DFU.[5]

One the biggest risk factor for DFU is peripheral arterial disease that has been reported with variable prevalence ranging from 11% to 78% and the incidence four times higher than non-diabetic individuals.[6, 7] A study reported a prevalence of DFUs up to 80% in type-2 diabetic patients and polyneuropathy (20%).[8] And it is potentiated by several demographic and biochemical markers like gender, dyslipidaemia (elevated total cholesterol, low high density lipoproteins, raised serum triglycerides), ischemic heart disease, diabetic kidney disease or nephropathy, infections (systemic and local foot infections) and smoking status.[9, 10 8]

Keeping in view the variable reported prevalence of PVD, difference in risk factors and predictors of DFUs in diabetic patients, this study was planned to assess the frequency of PVD in our local population reporting to our general surgical outpatient and associated risk factors with development of DFUs. It will help in timely evaluation and management of these underlying factors so that patients' outcomes will improve.

METHODOLOGY

This prospective observational cross-sectional study was conducted at the Department of General Surgery in collaboration with the Department of Vascular Surgery of Tertiary Care Hospital (Combined Military Hospital Rawalpindi and Pak Emirates Military Hospital Rawalpindi). The study commences after approval of the research proposal by the Institutional Ethical Review Board (Certificate # A/28/ERC562/123) in accordance with international and national guidelines for human research. The Sample Size of 264 patients was calculated using the OpenEpi sample size calculator, with a peripheral vascular disease prevalence of 78.04%, a confidence interval of 95%, and a margin of error of 5%. The patients were enrolled after informed consent through a non-probability purposive sampling technique.

Type 2 diabetes mellitus (T2DM) patients aged 18 years or older presenting with foot ulcers were included in the study.

Patients not willing to participate, those with dementia, sepsis, deep venous thrombosis, or autoimmune vasculitis were excluded. Moreover, patients with previous limb, foot, or toe amputation were also excluded.

The data were collected via face-to-face interviews in the respective outpatient departments (OPDs) at initial contact. Later, they were followed in the indoor patient departments (IPD) for those admitted or in the outpatient departments (OPD) for those called for outdoor follow-ups. The data were collected on basic demographic characteristics, including age, gender, educational status, employment status, area of residence, and smoking status. Clinical parameters such as duration of diabetes, previous comorbid conditions, physical exercise, and Glycaemic control were also noted. Laboratory investigation for glycosylated haemoglobin (HbA1C), Serum Total Cholesterol, and Serum Triglycerides was also done. The Ankle Brachial Index (ABI) was used to establish peripheral vascular disease (arterial). A certified radiologist assessed the ABI. An ABI of less than 0.9 was taken as a diagnostic threshold for peripheral arterial disease (PAD).

The descriptive statistics were used to represent data, which were analysed using the Statistical Package for Social Sciences version 25.0. The Shapiro-Wilk test was used to assess the distribution of the data. The factor influencing diabetic foot ulcers (DFU) were evaluated using binary regression analysis. A p-value <0.05 was taken as significant.

RESULTS

This study included two hundred and sixty-four patients (n=264) with a median age of 60.00 (46.00-68.00) years. There were 170 (64.39%) males and 94 (35.61%) females. Only 57

(21.59%) had peripheral vascular disease. The majority of patients, 92 (34.85%), had no formal education, followed by 78 (29.55%) with primary education. Among these 264 patients, 186 (70.45%) were employed, 123 (46.59%) lived in urban areas, 39 (14.77%) were smokers, 114 (43.18%) were hypertensive, and 85 (32.20%) had renal impairment (nephropathy). Only 99 (37.50%) were doing exercise, while 64 (24.24%) had coronary artery disease. Details are shared in Table I.

Table I: Distribution of Characteristics between the vascular and non-vascular ulcer groups

Characteristics	Descriptive Statistics
Median Age, years	60.00 (46.00-68.00)
Gender, n(%)	
Female	94 (35.61%)
Male	170 (64.39%)
Median Duration of Diabetes, months	60.00 (24.00-120)
HbA1C, %	8.05 (6.50-9.60)
Median Total Cholesterol, mg/dl	3.5 (2.20-4.57)
Median Serum Triglycerides, mg/dl	3.00 (2.42-3.80)
Educational Status, n(%)	
Illiterate	92 (34.85%)
Primary	78 (29.55%)
Secondary	29 (10.98%)
Higher Secondary	31 (11.74%)
University	34 (12.88%)
Employment Status, n(%)	
Employed	186 (70.45%)
Unemployed	78 (29.55%)
Residential Area, n(%)	
Rural	141 (53.41%)
Urban	123 (46.59%)
Smoking, n(%)	
Yes	39 (14.77%)
No	225 (85.23%)
Hypertension, n(%)	
Yes	114 (43.18%)
No	150 (56.82%)
CAD/IHD, n(%)	
Yes	64 (24.24%)
No	200 (75.76%)

Nephropathy, n(%) Yes No	 85 (32.20%) 179 (67.80%)
Physical Exercise, n(%) Yes No	 99 (37.50%) 165 (62.50%)
CAD/IHD: Coronary Artery Disease/ Ischemic Heart Disease; HbA1C: Glycosylated Haemoglobin	

A total of patients with diabetic foot ulcers were stratified into peripheral vascular disease (PVD) and non-PVD subgroups and compared across demographic, clinical, metabolic, and lifestyle characteristics. The subgroup analysis between patients with peripheral vascular disease (PVD Group) and patients with no peripheral vascular disease (Non PVD Group), there were more females 29 (50.88%), more unemployed 21 (36.84%), more rural area residents 41 (71.93%), more smokers 37 (64.91%), more hypertensive 40 (70.18%), and more nephropathy 39 (68.42%) patients, in PVD group compared to Non-PVD group which had 65 (31.40%) females, 57 (27.54%) unemployed, 100 (48.31%) rural area resident, 2 (0.97%) smokers, 74 (35.75%) hypertensive, and 46 (22.22%) nephropathy patients. Median age did not differ significantly between the PVD and non-PVD groups (p = 0.621). However, a significantly higher proportion of females was observed in the PVD group compared with the non-PVD group (50.9% vs. 31.4%; p = 0.007). Glycaemic control was significantly poorer among patients with PVD, with markedly higher HbA1c levels (p < 0.001). Similarly, median lipid parameters were significantly deranged in the PVD group, including higher total cholesterol (4.60 vs. 2.90 mg/dL; p < 0.001) and median serum triglyceride levels (3.80 vs. 2.90 mg/dL; p < 0.001). Smoking was significantly more prevalent among patients with PVD (p < 0.001). Additionally, hypertension was more common in the PVD group (p < 0.001). Similarly, coronary artery disease or ischemic heart disease (36.8% vs. 20.8%; p = 0.012) was more common in the PVD group. Details are show in Table II.

Table II: Distribution of Characteristics between the vascular and non-vascular ulcer groups

Characteristics	**Ulcer subgroups**		**p-value**
	PVD Group	**Non-PVD group**	
Age, years	60.00 (47.50-70.50)	60.00 (46.00-65.00)	0.621
Gender, n(%) Female Male	 29 (50.88%) 28 (49.42%)	 65 (31.40%) 142 (68.60%)	0.007
Duration of Diabetes, months	48.00 (18.00-90.00)	60.00 (30.00-120.00)	0.048
HbA1C, %	11.60 (9.85-12.60)	7.30 (6.20-8.80)	<0.001
Total Cholesterol, mg/dl	4.60 (4.10-5.25)	2.90 (1.80-4.00)	<0.001
Serum Triglycerides, mg/dl	3.80 (2.80-5.05)	2.90 (2.30-3.60)	<0.001
Educational Status, n(%) Illiterate Primary Secondary Higher Secondary University	 18 (31.58%) 16 (28.07%) 3 (5.26%) 9 (15.79%) 11 (19.30%)	 74 (35.75%) 62 (29.95%) 26 (12.56%) 22 (10.63%) 23 (11.11%)	0.216

Employment Status, n(%) Employed Unemployed	 36 (63.16%) 21 (36.84%)	 150 (72.46%) 57 (27.54%)	0.173
Residential Area, n(%) Rural Urban	 41 (71.93%) 16 (28.07%)	 100 (48.31%) 107 (51.69%)	0.002
Smoking, n(%) Yes No	 37 (64.91%) 20 (35.09%)	 2 (0.97%) 205 (99.03%)	<0.001
Hypertension, n(%) Yes No	 40 (70.18%) 17 (29.82%)	 74 (35.75%) 133 (64.25%)	<0.001
CAD/IHD, n(%) Yes No	 21 (36.84%) 36 (63.16%)	 43 (20.77%) 164 (79.23%)	0.012
Nephropathy, n(%) Yes No	 39 (68.42%) 18 (31.58%)	 46 (22.22%) 161 (77.78%)	<0.001
Physical Exercise, n(%) Yes No	 32 (56.14%) 25 (43.86%)	 67 (32.37%) 140 (67.63%)	0.001
CAD/IHD: Coronary Artery Disease/ Ischemic Heart Disease; HbA1C: Glycosylated Haemoglobin			

DISCUSSION

The prevalence of vascular diseases, especially peripheral arterial disease (PAD) or peripheral vascular disease (PVD), among patients with diabetic foot ulcers varies significantly across geographical regions and clinical settings, but it is generally estimated to be high among diabetic patients in middle- and high-income countries. In this study, too, an effort was made to identify the frequency of PVD in diabetic foot ulcer patients, and a comparison was made across different demographic, clinical, metabolic, and lifestyle characteristics. Among the 264 diabetic foot ulcer (DFU) patients, 57 (21.59%) had peripheral vascular disease with a median age of 60.00 (47.50-70.50) years. Compared with the non-PVD group, patients with PVD-associated ulcers showed significantly poorer glycaemic control, more severe dyslipidaemia, and a higher prevalence of CAD or IHD. PVD patients were more likely to be female, reside in rural areas, smoke, and have hypertension, coronary artery disease/ischemic heart disease, and diabetic nephropathy, as these demonstrated statistically significant associations with the PVD group. In coherence, physical exercise also differed significantly between groups. The duration of diabetes was slightly shorter in the PVD group, whereas age, educational status, and employment status were comparable between the two groups, with no statistical difference.

Different studies have reported a variable proportion of DFUs and then further again a variable proportion having DFUs due to peripheral vascular disease.[2, 10] A study conducted in Shaikh Zayed Hospital, Lahore, found a much higher frequency of PAD (64, 78.04%) in DFUs.[6] Comparatively, a lower prevalence (58.3%) was reported in another study conducted in Peshawar.[11] In Saudi Arabia (KSA) and Egypt, a prevalence of PAD was reported as low as 19.1% and 20% in cases of DFUs.[12] In this research, the prevalence of PVD was 21.59% which is comparable to studies conducted in KSA and Egypt, but very much lower than the local studies mentioned earlier. The differences in prevalence can be

due to different study population specifically inclusion and exclusion criteria, ethnicity and geographic variations, and differences in dependent clientele of the study settings. This also highlights the fact that it is difficult to assess the true prevalence of vascular abnormality mainly due to atypical symptoms and masking effects of diabetic peripheral neuropathy.

Increasing age has been associated with DFUs and vascular pathology in diabetics, while a mix of gender relevance has been reported; some have reported male predominance of PAD, but some regional studies have reported female predominance of the disease.[13-15] Similarly, the longer duration of diabetes and poor glycaemic control were also associated with PAD as hyperglycaemia is associated with endothelial dysfunction and vascular inflammation leading to advanced glycation end products. [13, 16, 17] Smoking, as a general and specifically in diabetes, has been a strong contributing factor to the development of vascular complications as it affects the blood flow and impairs wound healing.[9] In the present study, except for age, the gender (especially females), duration of diabetes, poor glycaemic control, and smoking were strongly associated with peripheral arterial disease, augmenting the evidence present in already published literature. The sex difference in the prevalence of DFUs is multifactorial, including regional differences, foot care practices, occupational exposure, access to health care facilities, and study settings.

Similarly, the comorbid conditions, such as hypertension, renal impairment (diabetic kidney disease), retinopathy (diabetic retinopathy), ischemic heart disease, and coronary artery disease, have a significantly higher prevalence in the peripheral vascular disease group.[12 8, 14, 18] Present research also demonstrated a higher prevalence of nephropathy, IHD, or CAD in the PVD group compared to the non-PVD group. Hypertension and dyslipidaemia are important contributing factors to the development of PVD.[14, 15, 19] In this study, too, hypertension and dyslipidaemia (raised total cholesterol and triglycerides) showed a significant association with PVD in DFU patients. This may be due to the contributing roles of lipids and hypertension in arteriosclerotic and atherosclerotic processes.

This was a single-centre tertiary care hospital study with a small sample size, in which more complicated patients are referred and managed; the results should be interpreted with caution. The workup for vasculitis was not performed; a proportion of cases might have underlying autoimmune phenomena masked by the effects of DFUs. Keeping this in mind, a multi-centre study with a large sample size and a prolonged follow-up should be conducted to identify underlying autoimmune factors and predictors of wound healing.

CONCLUSION

The peripheral vascular disease (arterial subtype) has a very high frequency in diabetic foot ulcers and is associated with multiple demographic, clinical, metabolic, and lifestyle characteristics, including gender, residential area, physical exercise, nephropathy, coronary artery disease, dyslipidaemia, hypertension, and duration of diabetes mellitus.

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