



EVALUATION OF THE 'FOOT AT RISK' IN DIABETES MELLITUS PATIENT

Surgery

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ABSTRACT

Background: Diabetes mellitus is a metabolic disorder which is characterized by multiple long-term complications that affect almost every system in the body. Foot ulcers are one of the main complications of diabetes mellitus. The present study was planned to find the prevalence of foot problems and determine the risk factors leading to Diabetic foot.

Methods: Total 140 type 2 diabetic patients were included; the demographic and clinical parameters were recorded and were tested for presence of neuropathy by means of pressure sensation examination using 10-gram monofilaments. Vascular examination was done with ankle-brachial index measurement.

Results: The mean age of the patients was 60.19 ± 12.21 years, and there were 93 (66.43%) were males and 47 (33.57%) were females. The prevalence of diabetic foot at risk reported to be 47.86%. Out of 67 patients with diabetic foot 34 (24.29%) had category 1 type with presence of LOPS $\pm$ deformity, while 33 (23.57%) had PAD $\pm$ LOPS based on task force of foot care interest Group ADA. A significant association of foot category was found with peripheral arterial disease, anti-diabetic treatment used, level of education, and economic status. A significant increase in the age and duration of diabetes among the patients who developed foot at risk was noted compared to without foot at risk.

Conclusion: Present study concludes presence of peripheral arterial disease, type of anti-diabetic drug, level of education and monthly income play very important role in development of diabetic foot in type 2 diabetic patients.

KEYWORDS

Type 2 diabetes mellitus, Diabetic foot, Foot ulcers, Peripheral arterial disease

INTRODUCTION

Diabetes is a global public health issue, with the greatest impact in developing countries such as India^[1]. With an estimated 109 million diabetics, India is expected to be the world's diabetes capital by 2035^[2]. According to the World Health Organization, 422 million adults had diabetes in 2014. (WHO). Diabetes is expected to affect 366 million people worldwide by 2030, with India having the highest number of diagnosed people^[1].

Diabetes can affect many organ systems in the body, leading to serious complications in the long run. Diabetic complications are classified into two types: microvascular complications and macrovascular complications. Damage to the nervous system (neuropathy), the renal system (nephropathy), and the eyes are all examples of microvascular complications (retinopathy). Heart disease, stroke, and peripheral vascular disease are examples of macrovascular complications. Peripheral vascular disease is characterised by bruising or non-healing injuries, gangrene, and, in the worst-case scenario, amputation.^[3,4]

Diabetes foot ulcers are one of the most common complications, a leading cause of hospitalisation, and account for nearly half of all non-traumatic amputations in diabetic patients.^[5-7] It is a severe and costly complication with a potentially fatal and/or limb-threatening condition^[8] caused by diabetic foot ulceration as a result of neuropathy, pressure, and/or ischemia. Ulcers can be classified based on the degree of tissue involvement/depth, the presence or absence of ischemia, and the presence or absence of infection.^[9]

Diabetes, peripheral neuropathy (motor, sensory, or autonomic), peripheral arterial disease, neuropathic arthropathy, and long-term diabetes are all risk factors for diabetic foot ulcers (prevalence of peripheral neuropathy increases as the duration of the disease increases).^[9,10]

Cellulitis, osteomyelitis (a potential complication of any infected foot ulcer, especially if chronic), sepsis, and the need for amputation are all possible diabetic foot ulcer complications.^[11] Amputation has a significant impact on a person's life, not only in terms of body image, but also in terms of lost productivity, increased dependency, and the costs of treating foot ulcers if patients require inpatient care.^[12]

With approximately 42 million cases of diabetes, India ranks first

among the ten most affected countries.^[13] Foot ulcers are the most common diabetes-related complication, affecting approximately 15% of Indian diabetic patients over the course of their lives.^[14]

This is because of a number of social and cultural practices, such as barefoot walking, a lack of diabetes care and education facilities, and poor socioeconomic conditions.^[15] Preventing diabetic foot ulcers is critical for lowering the condition's high morbidity and mortality rates, as well as the risk of amputation.^[16]

Identifying diabetics with diabetic foot risk and its associated factors is critical to reducing further complications and having baseline information to initiate appropriate interventions. There are few studies in the Indian subcontinent that look at the prevalence of diabetic foot and associated risk factors in diabetics. As a result, the current study was designed to ascertain the prevalence of foot problems as well as the risk factors that contribute to Diabetic foot.

METHODS

The present cross-sectional study was carried out in Department of Surgery, Bharati Vidyapeeth (DTU) Medical College and Hospital, Pune from October 2019 to August 2021. Total 140 Patients of either gender who were diagnosed with type 2 diabetes mellitus between the age group 18 to 70 years visiting OPD or admitted in Bharati Hospital, Pune during the study period were included by convenient sampling in the study after obtaining informed consent from each participant, the study was approved by institutional ethics committee.

Patients with diabetic foot ulcer are excluded from the study. Aim of the study is to evaluate the "Foot at Risk" In Diabetes Mellitus Patient. Objective of the study to determine the risk factors leading to Diabetic foot ulcer.

Methodology:

Patients visiting OPD or admitted to IPD of surgery department with type 2 diabetes mellitus as per inclusion criteria during the study period were enrolled. After inclusion in the study the demographic and clinical parameters were noted, including age, gender, body mass index (BMI), duration of diabetes, smoking & alcoholic status, educational status, monthly income, type of diabetes treatment (oral anti diabetic agents or insulin usage), history of diabetic foot ulcer, amputation and present foot ulcer. 3 ml of whole blood sample was

collected in a EDTA vacutainer from each participant to measure their HbA1c (HPLC, Bio-Rad).

Pressure sensation examination was performed by 10-gram monofilaments (Owen Mumford, UK) for the diabetic sensory motor polyneuropathy. We used nerve conduction test as an early and reliable indicator of the occurrence of this neuropathy. For vascular examination, dorsalis pedis, tibialis posterior, popliteal, and femoral pulses were assessed. ABI (ankle-brachial index) was measured by a handheld Doppler device. After completion of the examination, limbs were categorized based on task force of foot care interest Group ADA (Table 1). **Table 1: Categories of foot as per task force of foot care interest Group ADA.** [17] **Category of foot** Description 0 No LOPS, No PAD, No Deformity 1 LOPS+/- deformity 2 PAD+/- LOPS

STATISTICAL ANALYSIS:

The results obtained were entered into excel sheet, the qualitative data was presented as frequencies and percentages. Association between qualitative variables was assessed by Chi-Square test with Continuity Correction for all 2 X 2 tables and Fisher's exact test for all 2 X 2 tables. Quantitative data was presented using Mean $\pm$ standard deviation (SD). Difference in the means of quantitative parameters between the two groups was assessed using unpaired students t-test. A p-value <0.05 was considered significant. SPSS Version 21 was used statistical analysis.

RESULTS

The present study aimed to find the prevalence of diabetic foot among type 2 diabetic patients and to evaluate risk factors associated with it. Total 140 type 2 diabetic patients were included and evaluated; the mean age of the patients was 60.19 ± 12.21 years. The mean levels of HbA1c, duration of diabetes, BMI, ankle brachial index and results of 10 gm monofilament test were $8.75 \pm 1.86\%$, 10.44 ± 6.26 years, 26.15 ± 2.39 kg/m², 0.97 ± 0.23 and 8.90 ± 1.56 respectively. (Table 1) Out of 140 patients 93 (66.43%) were males and 47 (33.57%) were females.

Table 1: Demographic and clinical parameters

	Mean	Std. Dev.
Age (years)	60.19	12.21
HbA1c (%)	8.75	1.86
Duration of DM (years)	10.44	6.26
BMI (kg/ m ²)	26.15	2.39
Ankle brachial index	0.97	0.23
10 gm monofilament test	8.90	1.56

Out of 140 type 2 diabetic patients 14.29% were smokers and 18.57% were alcoholics. Most of the patients had secondary or lower level of education, compared to graduates (25.71%). Peripheral arterial disease was present at the time of evaluation among 25.71% of type 2 diabetic patients. 36.43% of patients were on insulin, while 63.57% were on oral hypoglycemic drugs (OHA). (Table 2)

Table 2: Distribution of gender and comorbidities and other socioeconomic factors

	N	%
Smoking	20	14.29
Alcohol	26	18.57
Peripheral arterial disease	36	25.71
History of previous foot care	25	17.86
Antidiabetic drugs	Insulin	51 36.43
	OHA	89 63.57
Educational level	Primary	59 42.14
	Secondary	43 30.71
	Graduates	36 25.71
Level of care	Primary	62 44.29
	Secondary	38 27.14
	Tertiary	40 28.57
Monthly income/month	10,001-20,000	38 27.14
	20,001-30,000	20 14.29
	>30,001	39 27.86
	Dependent	43 30.71

The prevalence of diabetic foot at risk among 140 type 2 diabetic patients studied was reported in the present study to be 47.86% (67 out of 140). Out of 67 patients with diabetic foot 34 (24.29%) had category 1 type with presence of LOPS $\pm$ deformity, while 33 (23.57%) had PAD $\pm$ LOPS. (Table 3)

Table 3: Incidence of diabetic foot as per category of diabetic foot at risk

Category of foot	Description	N	%
0	No LOPS, No PAD, No Deformity	73	52.14
1	LOPS+/- deformity	34	24.29
2	PAD+/- LOPS	33	23.57

LOPS, loss of protective sensation; PAD- peripheral arterial disease

The association of diabetic foot with various demographic, lifestyle and clinical parameters was tested by means of Chi-square test. A significant ($p < 0.0001$) association of category of foot was reported with peripheral arterial disease, type of anti-diabetic treatment used, level of education, indicating lower the level of education higher the chances of diabetic foot development, and economic status as monthly income was associated significantly ($p = 0.020$) with category of foot at risk. There was no significant ($p = 0.065$) association found between gender, smoking status ($p = 0.189$), alcoholic status ($p = 0.259$), history of previous foot care advice ($p = 0.536$), level of care ($p = 0.491$). (Table 4)

Table 4: Association of category of foot with gender

		Category of foot			P value
		0	1	2	
Gender	FEMALE	18	15	14	0.065
	MALE	55	19	19	
Smoking	Yes	9	8	3	0.189
	No	64	26	30	
Alcohol	Yes	15	8	3	0.259
	No	58	26	30	
Peripheral arterial disease	Yes	0	3	33	<0.0001*
	No	73	31	0	
Anti-diabetic drug	INSULIN	12	18	21	<0.0001*
	OHA	61	16	12	
Education level	GRADUATE	25	5	6	0.024*
	PRIMARY	33	13	13	
	SECONDARY	15	34	33	
History of previous foot care advice	Yes	12	5	8	0.536
	No	61	29	25	
Level of care	PRIMARY	36	15	0	0.491
	SECONDARY	16	11	11	
	TERTIARY	21	8	11	
Monthly income	10,001-20,000	25	4	10	0.020*
	20,001-30,000	25	9	4	
	>30,001	7	6	2	
	Dependent	16	15	12	

The means of demographic and clinical parameters were categorized as per the category of foot at risk and compared between the sub-groups. There was significant ($p < 0.0001$) increase in the age and duration of DM among the patients who developed foot at risk, while ankle brachial index, HbA1c and BMI did not differ significantly among the groups. (Table 5)

Table 5: Comparison of demographic and clinical parameters according to category of diabetic foot

	Category of foot	Mean	Std. Deviation	P value
AGE (year)	0	54.40	11.63	<0.0001*
	1	66.88	8.86	
	2	66.09	10.31	
Ankle brachial index	0	1.02	0.13	0.057
	1	0.91	0.09	
	2	0.94	0.42	
HBA1C	0	8.69	1.78	0.931
	1	8.82	1.83	
	2	8.81	2.14	
Duration of DM (in years)	0	7.26	4.29	<0.0001*
	1	13.68	5.86	
	2	14.12	6.81	
BMI in (kg/ m ³)	0	25.92	2.37	0.334
	1	26.15	2.36	
	2	26.67	2.51	

DISCUSSION

Patients with type 2 diabetes who have diabetic foot ulcers are more likely to develop chronic vascular diabetic complications. [18] Patients with type 2 diabetes may have misconceptions about foot

complications that are unsupported by scientific evidence. Such illness beliefs could contribute to previously unidentified foot-related behaviours. Providers of health care must investigate and address the beliefs that underpin patients' foot self-care habits.^[19]

Diabetic foot problems are one of the most common reasons diabetic patients are admitted to hospitals, and they impose a significant financial burden on patients, their families, and society as a whole. When compared to diabetes patients who do not have foot ulcers, the cost of care for DFS patients is 5.4 times higher in the first year and 2.8 times higher in the second year after foot ulcers appear.^[20,21] The global prevalence is estimated to be 6.3 percent^[22], with 15% of diabetics in India having it at some point in their lives.^[23]

The current study sought to determine the prevalence of diabetic foot among type 2 diabetic patients, as well as the factors that contribute to it. A total of 140 type 2 diabetic patients were evaluated, with a mean age of 60.19 ± 12.21 years. HbA1c levels were 8.75 ± 1.86 percent on average. Diabetes lasted an average of 10.44 ± 6.26 years. The gender distribution of patients revealed that males made up the majority of diabetes patients (66.43 %) compared to females (33.57 %). 14.29 percent of those polled were smokers, and 18.57 percent were alcoholics. In comparison to graduates, the majority of the patients had a secondary or lower level of education. Peripheral arterial disease was present in 25.71 percent of patients at the time of evaluation. Insulin was used by 36.43 percent of patients, while oral hypoglycemic drugs were used by 63.57 percent (OHA).

The primary goal of this study was to determine the prevalence of diabetic foot, which was found to be 47.86 % (67 out of 140). Out of 67 diabetic foot patients, 34 (24.29 %) had category 1 diabetes with LOPS deformity, while 33 (23.57 %) had PAD ± LOPS.

Azmi N et al [24] reported a prevalence of 31.3 % of type 2 diabetic patients with foot at risk in Kuantan, which was slightly lower than the current study. Iwase M et al.^[18] found a 2.9/1000 person-years incidence rate for diabetic foot ulcers and a 0.47/1000 person-years incidence rate for limb amputation. In patients with a history of diabetic foot ulcers, the recurrence rate was 21.4 %. Younis BB et al.^[25] discovered a 7.02 % prevalence of diabetic foot ulcers. Bruun C^[26] et al investigated the prevalence of foot ulcers at three different time points. Foot ulcers were discovered to be 2.76 %, 2.93 %, and 4.96 % at diabetes diagnosis, 6 years later, and 14 years later, respectively.

In their study, Muller IS^[27] et al discovered that the annual incidence of foot ulceration ranged from 1.2 to 3.0 percent per year, with a mean of 2.1; 25% of patients had recurrent episodes, and the annual incidence of lower limb amputation ranged from 0.5 to 0.8 %, with a mean of 0.6. The wide range of prevalence could be attributed to the various target populations, sample sizes, and classification systems used to categorize the at-risk foot.

The presence of peripheral arterial disease, type of anti-diabetic drug, level of education, and monthly income were all associated with a significant association of diabetic foot category in the current study. While there was no significant relationship found between foot category and gender, smoking status, alcoholic status, history of previous foot care advice, or level of care.

Iwase M^[18] et al. reported age, gender, diabetes duration, BMI, smoking, alcohol, HbA1c >8%, systolic blood pressure, chronic kidney disease, history of PAD, and CVD as statistically significant risk factors for diabetic foot ulcers. Megallaa MH^[19] and colleagues discovered a link between diabetic foot ulcers and diabetic complications, citing diabetic peripheral neuropathy (DPN) and peripheral arterial disease (PAD) as risk factors. According to Sayiner ZA^[28] et al., the presence of PAD and a history of diabetic ulcers were useful significant factors in amputation decision making. In their study on PAD, Iwase M^[18] et al found a similar pattern, with 28.6 percent of patients requiring limb amputation. Sahin, S^[29] et al. discovered a link between foot wound risk and gender and residential status.

Azmi N et al^[24] discovered a link between diabetes for more than ten years and an increased risk of developing foot problems. Furthermore, respondents who practise good foot care are 87 percent less likely to develop diabetic foot. Unlike the findings of a previous study. Foot ulcer prevention necessitates patient education, self-examination of the feet, and optimal blood glucose control. Preventing the life-

threatening complications of diabetic foot disease necessitates extensive knowledge and collaboration among physicians.

The age and duration of DM increased significantly among patients who developed diabetic foot, but ankle brachial index, HbA1c, and BMI did not differ significantly between groups. When Younis BB^[25] et al compared diabetic foot ulcers to those without, they discovered that those with diabetic foot ulcers had significantly higher mean age, HbA1c, and diabetes duration. A significant relationship was found between diabetic foot ulcers and age, diabetes duration, HbA1C, PN, and PAD in a regression analysis. According to Sahin S^[29] et al's multivariate analysis for the educational status variable, the difference can be attributed to the illiterate group. Ghosh P [30] et al. discovered that only the duration of DM was significantly associated in logistic regression.

CONCLUSION

The current study found that 47.86 percent of patients with type 2 diabetes mellitus from a tertiary teaching hospital had diabetic foot. The current study concludes that the presence of peripheral arterial disease, type of anti-diabetic drug, level of education, and monthly income all play a significant role in the development of diabetic foot in these patients, whereas no association was found for gender, smoking status, alcoholic status, history of previous foot care advice, and level of care. The regression analysis revealed that the risk of diabetic foot increased with increasing age and duration of DM in type 2 diabetic patients.

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