A study of risk factors and foot care behavior among diabetics

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ABSTRACT

Background: Diabetic foot results in considerable morbidity and mortality in developing countries and the prevalence of diabetes is expected to increase further in the next decades in these countries. Diabetic ulcers are the most common foot injuries leading to lower extremity amputation. Family physicians have a pivotal role in the prevention or early diagnosis of diabetic foot complications. Patient education regarding foot hygiene, nail care and proper footwear is crucial to reducing the risk of an injury that can lead to ulcer formation. **Materials and Methods:** This is a prospective study carried out from July 2013 to September 2015. Fifty patients of Diabetes with foot ulcer and two hundred without foot ulcers were examined. Risk factors and clinical profile of patients were studied which included age, gender, duration of diabetes, BMI, smoking, random BSLs history, hypertension, glycated haemoglobin levels, lipid profile, history of loss of sensation and history of amputation. MNSI questionnaire and MNSI practical assessment for neuropathy were administered to diabetic patients along with a pre-structured questionnaire regarding foot care practices. **Results:** In this study significant risk factors were peripheral neuropathy, peripheral vascular disease, gender, loss of sensation, duration of diabetes and smoking. MNSI questionnaire and practical assessment scores were higher in foot ulcer patients. Poor foot care practices were observed in patients with diabetic foot ulcer patients. **Conclusion:** Diabetic foot ulcers were more common in elderly males. Peripheral neuropathy, peripheral vascular disease, Smoking, trauma, duration of diabetes mellitus and high levels of glycated haemoglobin had significant association with occurrence of foot ulcers. MNSI scores had a high predictive value for development of foot ulcers amongst diabetics. Awareness regarding foot care was poor which underlines need to promote practice of foot care amongst diabetic population.

Keywords: Diabetic foot, foot care, glycated hemoglobin

Introduction

Diabetes mellitus (DM) is common throughout the world but is more common (especially Type 2) in the more developed countries. The Indian diabetic population is expected to increase to 57 million by the year 2025.[1] Diabetic foot ulcers (DFUs) are associated with significant morbidity and mortality, yet they are one of the most preventable long-term complications of DM. Early diagnosis and presentation to hospital for prompt treatment of DFU is capable of reducing the significant morbidity and mortality associated with this condition.[2] Early detection of peripheral neuropathy and patient's education regarding foot care and footwear is crucial in reducing risk of any injury that can lead to ulcer formation. This study has been undertaken to identify risk factors and assess the level of awareness of diabetic foot care among diabetic population reporting to our hospital.

Materials and Methods

Study population

This study was carried out on 250 diabetic patients from July 2013 to September 2015.

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Study design

This is a case-controlled study with diabetic patients recruited from outpatient clinics and inpatient wards in Dr. D.Y. Patil Medical College, Pimpri, Pune.

Study sample

The selected patients were subdivided into two groups (Group I: 50 patients with DFU and Group II: 200 patients without DFU). To carry out this research, the oral approval of the patients and approval of the Ethics Committee in the hospital were obtained.

Inclusion criteria

All cases of DM and DFU (outdoor and indoor) reporting to Dr. D.Y. Patil Hospital, Pimpri, Pune 18.

Exclusion criteria

Patients with amputations performed for other reasons such as trauma, tumor, and vascular disease or associated with entrapment neuropathies.

Statistical methodology

Sample size calculation - The following inputs were used for sample size calculation:
- Alpha error (exposure variable diabetes)
- Expected odds ratio (OR) 2.5
- Power 0.800.

Using the above inputs, the sample size was calculated using statistical software" Primer of Biostatistics" by SA Glantz.

The sample size derived was 90 for each group. Since a number of patients of DFUs were 50; hence, sample size of controls was increased in the proportion of 1:3 or more thus arriving at figure of 200 cases of diabetics without foot ulcer.
- Analysis of the data was done with the help of SPSS Statistics is a software package used for statistical analysis. Long produced by SPSS Inc., it was acquired by IBM in 2009. The current versions (2015) are officially named IBM SPSS Statistics. Companion products in the same family are used for survey authoring and deployment (IBM SPSS Data Collection), data mining (IBM SPSS Modeler), text analytics, and collaboration and deployment (batch and automated scoring services)
- Association of various risk factors measured categorically with DFUs was explored with OR with 95% confidence intervals and Chi-square test, Z-test, and OR with proportion test. Interaction between various risk factors was explored by multivariate analysis
- Foot care behaviors score data were statistically analyzed using independent two groups score data - the Mann–Whitney U-test (nonparametric test).

Demographic details, duration of diabetes, history of smoking and trauma, body mass index, and presence of hypertension were recorded for all patients in both study groups. Feet were examined for any deformity and ulcer and graded according to Wagner's classification. The neurological examination of feet was performed by administering Michigan Neuropathy Screening Instrument (MNSI), which had two components, Michigan Neuropathy Sensitivity Instrument Questionnaire (MNSI-Q) and Michigan Neuropathy Sensitivity Instrument Questionnaire Practical Assessment (MNSI-PA), was used to identify high-risk feet.[3] Touch sensation was assessed using the Semmes–Weinstein monofilament.

Assessment of peripheral arterial disease was done by clinical examination as well as color Doppler studies.

Fundoscopy examination was performed by ophthalmologist. Specific investigations consisted of blood sugar, hemoglobin A1c (HbA1c) levels, and lipid profile.

Response to a structured questionnaire regarding foot care awareness among both groups was recorded.[4]

Results

Age and gender were not significantly related to the risk of DFU ($P > 0.05$). The mean duration of diabetes was significantly higher in the DFU patients group (7.08 5± 4.48 years) compared with diabetic patients without foot ulcer (4.01 ± 2.34). Hence, the risk of DFUs was higher in patients who had a long duration of DM (>10 years) ($P < 0.001$, OR = 8.56) [Table 1].

The percentage of smokers was significantly higher in the DFU patients group (72%) compared with diabetic patients without foot ulcer (30%). DFUs were six times more in smokers than nonsmokers ($P < 0.001$, OR = 6), almost five times more in patients who had lost touch sensation ($P < 0.001$, OR = 4.95), and eight times more in patients who had HbA1c > 7.5% ($P < 0.001$, OR = 8.10) [Tables 1-3].

Previous history of trauma was recorded among 48% of DFU patients. The percentage of patients with foot fissure, callus, and deformities were significantly higher among DFU patients (66%) compared with diabetic patients without foot ulcer (28%).

Serum triglycerides, fasting and postprandial glucose, and HbA1c levels were higher in patients with DFU.

Loss of touch and vibration sensation was recorded among 48% of DFU patients. The percentage of patients with loss of touch and vibration sensation was significantly higher among DFU patients compared with diabetic patients without foot ulcer.

Doppler examination detected lower limb ischemia in six diabetic patients with foot ulcer. However, diabetic patients without foot ulcers had no evidence of limb ischemia.

Table 1: Comparison of demographic data between Group A and Group B

	Mean±SD		P
	Group A (*n*=50)	Group B (*n*=200)	
Age (years)	58.44±8.94	58.45±9.96	>0.05
Gender			
Male	44 (88)	148 (74.50)	<0.05*
Female	6 (12)	52 (25.50)	
Duration (years)	7.08±4.48	4.01±2.34	<0.0001**
Body mass index (kg/m²)	21.55±1.63	20.74±1.23	<0.0001**
Smoking			
Yes	36 (72)	60 (30)	<0.0001**
No	14 (28)	140 (70)	
Hypertension (mmHg)			
Yes	9 (18)	56 (28)	>0.05
No	41 (82)	144 (72)	
History of trauma			
Yes	24 (48)	0	<0.0001**
No	26 (52)	200 (100)	
Peripheral neuropathy			
Yes	12 (24)	12 (6)	<0.0001**
No	38 (76)	188 (94)	

*Significant, **Highly Significant. SD: Standard deviation

Table 2: Comparison of laboratory data between Group A and Group B

	Group A	Group B	P value
Triglyceride (mg %)	112.26±32.49	73.07±29.22	<0.0001**
HbA1c (%)			
>7.5	44 (88)	95 (47.50)	<0.0001**
<7.5	6 (12)	105 (52.50)	
BSL (mg/dl)			
Un controlled	25 (50)	18 (9)	<0.0001**
Controlled	25 (50)	182 (91)	
Color Doppler			
Abnormal	6 (12)	0	<0.0001**
Normal	44 (88)	200 (100)	

**P<0.0001 – Highly significant, *P<0.05 – Significant. P>0.05 – Nonsignificant. BSL: Blood sugar level; HbA1c: Glycated hemoglobin

Mean score using MNSI Q in this study was 6.24 (standard deviation [SD] 1.66). The prevalence of neuropathy (MNSI PA score >2.5) was 47% in the study group [Table 4].

Mean score obtained in foot care practice was 4.92 (SD 0.88) in Group A patients and 6.01 (SD 1.22) in Group B patients [Table 4].

Discussion

Foot ulcer is a disabling complication in patients with DM. The disability and possible progression to the loss (amputation) of digits and limbs make it a serious issue.[5]

Age was not a significant factor in both groups. This is similar to the study by Al Kafrawy *et al.* who found no difference in the prevalence of DFU in age group.[6] Male patients were found

Table 3: Odd ratio of different parameters as risk factors for foot ulcer in diabetic cases

Parameters	Group A (*n*=50)	Group B (*n*=200)	OR (95%CI)	P
Age>50 years	40	152	1.26 (0.59-2.72)	>0.05
Sex: Male	44	148	2.58 (1.04-6.39)	<0.05*
Duration of diabetes mellitus >10 years	9	5	8.56 (2.73-26.87)	<0.0001**
Smoking	36	60	6 (3.02-11.93)	<0.0001**
Hypertension (mmHg)	9	56	0.56 (0.26-1.24)	>0.05
Peripheral neuropathy	12	12	4.95 (2.07-11.84)	<0.0001**
HbA1c >7.5 (%)	44	95	8.10 (3.30-19.88)	<0.0001**
BSL (mg/dl)	25	18	10.1 (4.84-21.11)	<0.0001**

*Significant, **Highly Significant. BSL: Blood sugar level; HbA1c: Glycated hemoglobin; CI: Confidence interval; OR: Odds ratio

Table 4: Comparison of Michigan neuropathy sensitivity questionnaire, Michigan neuropathy sensitivity questionnaire Practical assessment, and foot care behavior between Groups A and B

	Mean±SD		P
	Group A (*n*=50)	Group B (*n*=200)	
Michigan neuropathy sensitivity questionnaire	6.24±1.66	2.22±1.99	<0.0001**
Michigan neuropathy sensitivity questionnaire practical assessment	2.45±0.98	1.12±0.42	<0.0001**
Foot care behavior	4.92±0.88	6.01±1.22	<0.0001**

**Highly Significant. SD: Standard deviation

to be more affected with foot ulcers, whereas there were more female patients suffering from diabetes without foot ulcer in our study. This is similar to the cross-sectional studies carried out by Frykberg *et al.* who found that male sex was identified as a risk factor for DFUs.[7]

We observed that the mean duration of diabetes was significantly higher, that is, 7.5 years in DFU patients, whereas it was 4 years in non-DFU patients (*P* < 0.001). This is in agreement with other studies that showed that long duration of diabetes was the main factor causing DFUs.[8,9]

Smoking was a significant risk factor for DFU in our study. This is similar to the study of Moss *et al.* who found that smoking was predictive of foot ulceration and amputation.[10]

History of trauma was observed in 48% of cases. Similar findings were observed in which trauma was the predisposing factor in nearly every case.[11] In another study, overt trauma was reported in 48.8% of patients and the quality of footwear of most patients was undesirable, having a relatively hostile interior.[12]

In this study, peripheral neuropathy as assessed by MNSI score and practical assessment was found to be significant

in patients with DFU. Previous studies have shown that peripheral neuropathy is a strong independent risk factor for the development of DFU.[13,14] Prevalence of peripheral neuropathy was 47% in our study compared to 15–16% in other studies.[15,16] This could be because of the variations in the instruments used to detect peripheral neuropathy.

Elevated levels of HbA1c were observed in patients with DFU. Previous studies have also shown that HbA1c was a contributory factor for DFU.[9,17]

Serum cholesterol, HDL, and LDL were normal in patients with or without foot ulcer. However, serum triglycerides were raised amongst DFU patients.

Peripheral vascular disease is a major risk factor. Abnormal color Doppler findings were observed in six patients of DFU.

The lack of knowledge regarding foot care in the current study is consistent with findings by other investigators worldwide.[18,19] In a study done in Chennai, only 33% of the patients obtained good scores on knowledge regarding foot care.[19] Various studies from other developing countries such as Nigeria and Iran also showed poor awareness regarding foot care.[4,20]

With the presence of high prevalence of peripheral neuropathy in the population, screening for neuropathy, and foot complications is recommended in all patients on a regular basis. Periodic examination of the foot by the patient as well as by primary health care provider is a must in all patients with diabetes.

A patient-friendly educational intervention coupled with regular physician reinforcement is needed to reduce the gap in the knowledge of foot care among the diabetics and to reduce the risk of DFUs and amputations.

Conclusion

Our study showed significant association for DFU with peripheral neuropathy, peripheral vascular disease, duration of diabetes, smoking, and abnormal glycated hemoglobin. Most of the risk factors related to DFU are correctable or at least controllable, with an opportunity for early prevention and treatment of foot ulcers. A focused campaign is required to educate patient as well as primary health care workers to detect risk factors and spread awareness regarding foot care and its practice in the rural and urban population of India as a preventive strategy.

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Conflicts of interest

There are no conflicts of interest.

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