Sudan Journal of Medical Sciences
Volume 15, Issue no. 2, DOI 10.18502/sjms.v15i2.6750
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Research Article

The Risk Factors of Developing Diabetic Foot Ulcers Among Diabetic Patients in Mukalla City-Hadhramout/Yemen

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Abstract

Background: Diabetes is on the rise worldwide and is already considered as an epidemic by some experts. So, there is a need to raise awareness on the important factors that can help prevent bacterial infection in wounds of patients with diabetes.

Objective: To study the risk factors of developing diabetic foot ulcer (DFU) in patients with diabetes. The study is the first in Yemen to investigate the prevalence of bacterial infection in wounds of diabetic patients.

Materials and Methods: This is a case-control study carried out from November 2018 to May 2019. Twenty diabetic patients with foot ulcer and twenty without foot ulcer were examined. Risk factors and clinical profile of patients were studied by using a standardized questionnaire that included gender, age groups, past history of diabetes, duration of the disease, type of diabetes, DFU, type of ulcer, smoking, glucose level, and control of blood glucose level.

Results: The risk factors that affected significantly the occurrence of DFU were gender (0.038), age groups (0.010), and duration of diabetes mellitus (DM) while hyperglycemic control, smoking, and family history were not. There was no significant difference (0.977) in mean fasting blood glucose (MBG) between the DM and DFU patients.

Conclusions: Male diabetic patients aged more than 55 years and suffering from DM for more than 10 years were most likely to have DFU.

Keywords: diabetic foot ulcer, diabetes mellitus, risk factors, Yemen

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Received 6 May 2020
Accepted 23 June 2020
Published 30 June 2020

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Editor-in-Chief:
Prof. Mohammad A. M. Ibnouf

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1. Introduction

Foot ulcers remain one of the most significant and devastating complications of diabetes and an extremely distressing problem among diabetic patients [1]. Every year, more than 1 million people lose a leg as a consequence of this disease worldwide [2]. Patients with diabetes may present to the hospital with different levels of foot lesions [3]. Several studies have specifically assessed factors associated with the occurrence of a DFU. Characteristics that have been shown to confer a risk of foot ulceration in persons with diabetes include gender, longer duration of diabetes, previous ulceration or amputation,

fasting blood glucose (FBG), high HbA1C levels, smoking and inappropriate foot selfcare habits [4]. In DFU patients, long-term glycemic control is desirable. The standard of care in diabetes management is self-monitoring of blood glucose at any time.. Blood glucose monitoring frequency should be individualized and adapted to address the goals of diabetes care [5]. Also, a longer duration of diabetes and smoking increases the risk of foot ulcer [6].

2. Materials and Methods

Twenty diabetic patients with foot ulcer (DFU) and twenty without DFU were obtained and diagnosed by the doctors in Mukalla city's hospitals during the period from November 2018 to May 2019. Data related to risk factors of DFU was collected using a standardized questionnaire consisting of systematic questions about study variables, which was used to interview the participants. The variables included in the questionnaire were gender, age groups, past history of diabetic, duration of diabetic disease, type of diabetes, DFU, type of ulcer, smoking, glucose level, and control of blood glucose level. The blood samples were taken from the volunteers after 8–10 hr of fasting. The blood glucose test was done according to the instructions of kit manufactured by SPECTRUM company using Stat Fax Spectrophotometer instrument. And CBC test was done according to the instructions of full automated hematology analyzer instrument. Data analysis was conducted using the software of Statistical Package for Social Sciences (SPSS) version 25. The graphs were presented using the software program (Excel for Windows Microsoft) version 10. Descriptive statistics (frequencies, percentages, mean, and standard deviation) for the study variables were obtained and compared using *t*-test. The association between different categories of the explanatory variables was measured and compared using Pearson Chi-square ($\chi 2$) test. The level of significance was set at $P\text{-}value < 0.05$.

3. Ethical Considerations

Ethical approval for this study was obtained from the Hadhramout University before commencing the study. The information were taken from the participants after they agreed gave verbal consent according to the informed consent with confidentiality of each participant as well as the results.

4. Availability of Data and Material

This work was supported by different hospitals in Mukalla city – Hadhramout includes Ibn-Sina Teaching Hospital, Hadhramout Modern Hospital, University Hospital for GYNOBST and Pediatrics, Al-Riyan Specialized Hospital, Al-Borj Consultant Hospital and Al-Madina Polyclinic, as well as the Medical Microbiology Department at the National Center For Public Health Laboratories, Hadhramout branch, Yemen.

5. Results

Of the 20 diabetes mellitus (DM) patients, 11 (55%) were male and 9 (45%) were female, and their age group distribution were as follows: two (10%) were < 18 years, six (30%) were 18–25 years, three (15%) were 26–35 years, one (5%) was 36–55 years, eight (40%) were more than 55 years; 45% of them were suffering from DM for < 5 years, 35% for 5–10 years, and 20% for > 10 years.

On the other hand, in the DFU patients group, 17 (85%) were male and 3 (15%) were female. Their age group distribution was as follows: zero (0%) were < 18 years, zero (0%) were 18–25 years, one (5%) was 26–35 years, five (25%) were 36–55 years, and fourteen (70%) were > 55 years.

Table 1 shows the relationship of diabetes and DFU with demographic characteristics (gender and age groups). Males were infected more than females. The age groups 18–25 and > 55 years were infected more with diabetes and age groups 36–55 and > 55 years were infected more with DFU. A statistically significant association ($P < 0.05$) was observed in the study.

According to the studied data of clinical characteristics, the duration of DM was highly significant in relation to the occurrence of DFU (*P-value* 0.001). Other factors such as hyperglycemic control, smoking, and family history showed insignificant relation to DFU. Table 2 shows the relationship of diabetes and DFU with clinical characteristics.

As shown in Table 3, the mean of FBG levels in DFU patients was higher than the DM patients, but there was no significant difference between the means of DM and DFU patients.

6. Discussion

The complication of foot ulcer in DM patients is one of the significant medical problems and an economic burden, therefore identifying the risk factors might help to develop

Table 1: Frequencies and percentages of diabetic and DFU patients in relation to demographic characteristics

Demographic characteristics		Diabetes mellitus	Diabetic foot ulcer	Total (%)	χ^2 test value	P-value
		No. (%)	No. (%)			
Gender	Male	11 (27.5%)	17 (42.5%)	28 (70%)	4.286	0.038*
	Female	9 (22.5%)	3 (7.5%)	12 (30%)		
	Total	20 (50%)	20 (50%)	40 (100%)		
Age groups (years)	< 18	2 (5%)	0 (0%)	2 (5%)	13.303	0.010*
	18–25	6 (15%)	0 (0%)	6 (15%)		
	26–35	3 (7.5%)	1 (2.5%)	4 (10%)		
	36–55	1 (2.5%)	5 (12.5%)	6 (15%)		
	> 55	8 (20%)	14 (35%)	22 (55%)		
	Total	20 (50%)	20 (50%)	40 (100%)		

*Statistical significance at *P-value* < 0.05

Table 2: Frequencies and percentages of diabetic and DFUs patients in relation to clinical characteristics

Clinical characteristics		Diabetes mellitus	Diabetic foot ulcer	Total (%)	χ^2 test value	P-value
		No. (%)	No. (%)			
Hyper-glycemic control	Yes	9 (22.5%)	9 (22.5%)	18 (45%)	0.000	1
	No	11 (27.5%)	11 (27.5%)	22 (55%)		
	Total	20 (50%)	20 (50%)	40 (100%)		
Duration of diabetes mellitus	< 5 years	9 (22.5%)	1 (2.5%)	10 (25%)	15.2	0.001*
	5–10 years	7 (17.5%)	3 (7.5%)	10 (25%)		
	> 10 years	4 (10%)	16 (40%)	20 (50%)		
	Total	20 (50%)	20 (50%)	40 (100%)		
Smoking	Yes	6 (15%)	7 (17.5%)	13 (32.5%)	0.114	0.736
	No	14 (35%)	13 (32.5%)	27 (67.5%)		
	Total	20 (50%)	20 (50%)	40 (100%)		
Family history	Yes	10 (25%)	12 (30%)	22 (55%)	0.404	0.525
	No	10 (25%)	8 (20%)	18 (45%)		
	Total	20 (50%)	20 (50%)	40 (100%)		

*Statistical significance at *P-value* < 0.05

better prevention strategies in diabetic patients. This study focused on the risk factors that lead to the incidence of DFU in diabetic patients.

In this study, males had a higher incidence of DFU than females with 70%. Similar results were observed in many studies globally, in Australia 66.2% [7], China 63.8%

Table 3: The difference between fasting blood glucose level in diabetic and diabetic foot ulcers patients

Category	Fasting blood glucose levels (mg/dl)		t-test	P-value
	Mean	Standard deviation		
Diabetes mellitus	197.7	89.1	–0.029	0.977
Diabetic foot ulcer	198.5	83.1		

[8], India 71.7% [9], Pakistan 59% [10], Iran 70% [11], Egypt 65% [12], Iraq 72% [13], and United Arab Emirates 76.3% [14], whereas the findings were completely different with Nigerian study that reported females were more affected with DFU 62.0% [15]. And there was un significant associated with gender as the findings reported with [16, 17]. Our results showed a significant effect of gender among DFU patients, which is similar to a Jordanian study [18]. Males are more affected by DFU, possibly due to the burden of life and their exercise habits since male population is more exposed to harder work with higher risk of trauma in work zone [9].

In our study, the age group > 55 years was the most frequent with DFU, followed by the age group of 36–55 years and 26–35 years. This is similar to some other studies carried out in different countries, where the elderly population (> 50 years) was more likely to get diabetic foot complications in India [19] and Egypt [20]. Another study revealed that the most common age groups of diabetic patients with foot involvement were at the fourth and fifth decades [21]. Other studies showed that the foot diseases were more common in diabetic individuals aged > 60 years in the United States of America [22] and India [23, 24]; this might be because older age poses the risk of diminished ability for self-care due of poor vision and impaired mobility. The absence of these factors in younger patients may make them less susceptible to foot trauma [25]. Also, we found that diabetic patients aged < 25 years do not grow DFU. Shanmugam *et al.* indicated that the age range of DFU is 35–80 years [24], so this is a little different from our study results.

In this study, a direct and statistically significant (P = 0.001) relationship was found between the duration of DM and the presence of DFU in diabetic patients, similar to the study reported in [18]. Also, the study found that the patients with DM for > 10 years were most likely to have DFU with a rate of 50%, followed by those with DM for 5–10 years and < 5 years with a rate of 25% of each; these results were in agreement with an Iraqi study results [17]. Other studies revealed that the duration of diabetes was > 10 years in 58%, 94%, and 61.41% in India [21], Egypt [16], and Pakistan [25], respectively. This is most likely because of other risk factors such as peripheral neuropathy and peripheral vascular disease developing with time [16]. In contrast, different findings were seen

in some studies. A study showed that patients with a duration of DM between 5 and 10 years of were more likely to have DFU [9]. However, Bhaktavatsalam and Chavan showed that the patient with DM for < 5 years were most likely to be affected with DFU [26]. This variance in the results might be because the complications are not only dependent on duration but also on the level of chronic glycemia [5].

Most DFU patients in this study had poor glycemic control (55%) with no statistically significant relationship between the incidence of DFU and hyperglycemic control as previously reported by other studies carried out in India (70%) [21], Pakistan (69%) [27], and Saudi Arabia (66%) [28].

In our study, 60% of the diabetic patients had a family history of diabetes. But historical family wasn't considered as a risk factor in (*P-value* ≥ 0.05). Similar findings were reported by other studies where family history of diabetes was not associated with DFU [3–26].

In this study, 32.5% of diabetic patients had a history of smoking with no significant association with development of diabetic foot complications; this is similar to the study that reported smoker's rate in DM patients as 30% [29]. However, higher rates, that is, 44% [6], 61.3% [9], and 70% [30], were also seen in other studies, as well as lower rates were reported in studies carried out in Western Sydney, Australia 14.5% [7], Pakistan 9% [27], India 14.8% [23], and Iran 8.1% [31]. Besides, several other studies [16, 26, 28, 30] reported statistically significant association between smoking and DFU.

Our findings showed that the mean FBG levels were higher in patients with DFU (198.4mg/dl) than patients without foot ulcers (197.7mg/dl) with no significant association with the incidence of DFU. These findings correlated with some studies carried out in Iraq, in [32], the mean FBG was 222.35 mg/dl and 258.5 mg/dl for DM and DFU patients, respectively, [33] reported 190.1 mg/dl and 223.2 mg/dl for DM and DFU patients, respectively, , and [34] shows 215mg/dl and 128mg/dl for DFU and DM patients, respectively, with highly significant association. Similar results were reported in Iran [31], Egypt [12], and United Arab Emirates [14], and other study that adopted HbA1c to evaluate the blood sugar levels [30]. These differences in the results may be due to the techniques used to measure the blood glucose levels. A1c is probably a better measure of the relationship between blood glucose levels and developing diabetic foot complications than an FBG measurement.

7. Conclusion

Gender, age groups, and duration of DM were the risk factors that contributed most to the development of DFU. Hence, diabetic patients should be wary of their lifestyle and follow-up regularly on their health to avoid development in their case with age advancement. Also, glucose control should be advised by doctors to their diabetic patients.

Acknowledgements

The authors are thankful to the Department of Biology, Faculty of Science, Hadhramout University, Yemen, for its efforts in developing scientific research.

Funding

The study did not receive any fundings.

Conflict of Interest

The authors declare that they there is no conflict of interest.

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