Article published online: 2022-07-07

Original Article

Characteristics of Diabetic Foot Disease and Risk Factors in Benghazi, Libya

Najat Buzaid[1], Fatma Nagem[1]

[1]Department of Internal Medicine, Faculty of Medicine, University of Benghazi and Benghazi Medical Center, Benghazi, Libya

Abstract

Introduction: Diabetic foot ulcer and amputation are associated with an increased incidence of morbidity and mortality. Diabetic foot ulcer can be prevented by screening for risk factors and proper interventions. **Objectives:** We aimed to determine the risk of diabetic foot ulcer and amputation among patients with type 2 diabetes at Benghazi Medical Center diabetic clinic. **Patients and Methods:** A cross-sectional study of diabetic foot status and risk factors in diabetic patients attending a specialist diabetes clinic in Benghazi, Libya. **Results:** Eighty-seven (84.5%) patients wear inappropriate shoes, 37 (35.9%) had *Tinea pedis*, 26 (25.2%) had foot deformity, 13 (12.6%) patients had bilateral hallux valgus deformity, 8 (7.8%) patients had clawing of feet, 2 (1.9%) patients had Charcot joint, and one patient (0.97%) had amputated toes. Dorsalis pedis and posterior tibial arteries pulsations were not palpable in six (5.8%) patients, there was a loss of protective sensation among 20 (19.4%) patients, vibration sense was absent in 15 (14.6%) patients, and joint position sense was lost in five (4.9%) patients. According to Scottish Intercollegiate Guideline Network system, 59 (57.3%) patients were in the low-risk category, 18 (17.5%) were in the moderate-risk, 22 (21.4%) were in the high-risk, and 4 (3.9%) were in the active disease categories. **Conclusions:** We conclude that the prevalence of diabetic foot risk factors is high among the studied group.

Keywords: Benghazi, diabetes, foot, risk, ulcer

Introduction

Diabetes mellitus (DM) is one of the common diseases worldwide. Diabetic foot ulcer and amputation are related to increased mortality, morbidity, as well as economic and psychological burden, among diabetic patients. The global incidence of diabetic foot ulcer is 6.3%, and its incidence in Africa is 7.2%.[1] There is a 30-fold greater risk of lower limb amputation and a 10-fold greater risk for foot infection among diabetic patients in comparison to individuals without diabetes.[2,3] In one study in Libya, 1.1% of diabetic patients had lower limb amputation.[4]

Risk factors of diabetic foot ulcer include peripheral neuropathy, peripheral vascular disease, foot deformity, callus, previous foot ulcer, previous lower limb amputation, end-stage renal disease, poor vision, inability to reach feet, poor glycemic control, and tobacco smoking.[5] There are several risk stratification systems for predicting the development of diabetic foot. The Scottish Intercollegiate Guideline Network system (SIGN), which has a high diagnostic accuracy, is easy to use and inexpensive.[6,7] Early detection of diabetic foot risk factors and proper intervention can prevent the development of diabetic foot ulceration and amputation. The applicability of internationally developed risk assessment schemes and clinical management guidelines to local and regional circumstances is a prerequisite for their implementation. Hence, this study examined the characteristics and risk factors of diabetic foot disease in a new location.

Access this article online

Quick Response Code:

Website: www.ijmbs.org

DOI: 10.4103/ijmbs.ijmbs_39_18

Patients and Methods

Design

We aimed to determine the characteristics and risk factors for diabetic foot ulceration and amputation among patients with type 2 DM (T2DM) at Benghazi Medical Center (BMC) diabetic clinic in a cross-sectional observational study. This

Address for correspondence: Dr. Najat Buzaid, Department of Internal Medicine, Faculty of Medicine, University of Benghazi and Benghazi Medical Center, Benghazi, Libya.
E-mail: najatbuzaid2013@gmail.com

How to cite this article: Buzaid N, Nagem F. Characteristics of diabetic foot disease and risk factors in Benghazi, Libya. Ibnosina J Med Biomed Sci 2018;10:165-8.

study was approved by the Research Ethics Board at the BMC. A sample of 103 patients with T2DM, who were referred to the BMC diabetic clinic, were studied during the period from February 2017 to September 2017. Patients were interviewed, and foot examination was recorded.

Evaluations

Assessments included inspection for inappropriate footwear (too short shoes, high heel shoes, pointed-toe shoes, and narrow-rounded shoes), skin discoloration, fungal infection between toes, foot deformity, callosity, nail abnormality, Charcot joint, and foot ulcer. Vascular assessment was performed by palpation of dorsalis pedis and posterior tibial arteries. Testing for loss of protective sensation using a 10-g Semmes-Weinstein monofilament at five points in each foot, inability to feel the monofilament on more than one out of ten sites is considered as altered sensation.[8,9] Vibration using a 128 Hz tuning fork, and joint position sense were also tested.

Risk factors

Recorded data include age, gender, duration of diabetes, history of end-stage renal disease, tobacco smoking, a history of previous ulcer or amputation, proliferative retinopathy, poor vision, and the ability of patients to reach their feet. Body weight and height were measured, and body mass index (BMI) was calculated. Blood pressure was measured; glycated hemoglobin (HbA1c), low-density lipoprotein cholesterol (LDL-C), triglycerides, and high-density lipoprotein cholesterol (HDL-C) were measured; and results were interpreted according to the American diabetes association guidelines 2018; a systolic blood pressure of ≥140 mmHg and a diastolic blood pressure of ≥90 mmHg were considered as an elevated blood pressure. A glycated HbA1c of ≥7% is considered as elevated, and an LDL-C of ≥100 mg/dl and triglycerides of ≥150 mg/dl were considered elevated, and an HDL-C of <40 mg/dL for men and <50 mg/dL for women was considered abnormal.[10]

Risk stratification

Diabetic foot risk stratification was interpreted according to the SIGN risk scale updated in November 2017.[7] Low-risk foot has no risk factors present and no loss of sensation or absent or diminished pulses. Moderate risk has one risk factor present such as loss of sensation, absent or diminished pulses without a callus or deformity, and significant visual impairment or physical impairment. Whereas in the high-risk foot, there is a history of previous amputation or ulceration or two or more risk factors present such as loss of sensation, absent or diminished pulses, peripheral arterial disease, foot deformity with a callus, preulcerative lesions, or end-stage renal failure. Finally, the active disease is indicated by the presence of active ulceration or suspected Charcot foot, severe or spreading infection, or critical limb ischemia.[7]

Statistical analysis

Data were analyzed using the SPSS Statistics version 24 (SPSS Inc., Chicago, IL, USA). Variables were expressed as numbers, percentages, mean, and standard deviation as appropriate. Differences between the variables were explored using Chi-square test, and $P < 0.05$ was considered statistically significant.

Results

Demographic and clinical characteristics

There were more females than males in the sample. The mean age was 57 years, and the mean duration of diabetes was 9 years. A history of previous ulcer or amputation was present in two patients, and six patients were smokers. One-fifth could not reach their feet. Two-thirds had an elevated HbA1c, and 16.5% had an HbA1c of ≥10%. BMI was >30 among 45.5% (10/22) of males and 74% (60/81) of females ($P = 0.03$). Thirty-nine (37.9%) patients had high blood pressure, 51 (49.5%) patients had an elevated LDL-C, 26 (25%) patients had high triglycerides, and 56 (54%) had a low HDL-C [Table 1]. The prevalence of positive microalbuminuria was 63.6% (14/22) among males, and 38% (31/81) among females ($P = 0.07$).

Physical characteristics

The relevant physical examination findings are shown in Table 2. Fungal infection and skin callosities were common. Bilateral hallux valgus deformity was common and clawing of feet was less common. Charcot joint deformity was seen in two patients. Ingrowing nails and onychomycosis were seen in a smaller number (six and three, respectively) while one patient had amputated toes in one foot, bilateral overriding toes

Table 1: Demographic, clinical, and metabolic profiles of the study population

Variables	Details
Gender (%)	
Males/females	22 (21.4)/81 (78.6)
Age (years)	57.7±11.5
Duration of diabetes (years)	9±8
History of previous ulcer/amputation (%)	3 (2.9)/1 (0.97)
Cannot reach their own feet (%)	22 (21)
Current smokers (%)	6 (5.8)
Inappropriate footwear (%)	87 (84.5)
BMI >30 kg/m^2 (%)	
Males	10 (45.5)*
Females	60 (74)
High BP (%)	39 (37.9)
HBA1c above 7%/10%	68 (66)/17 (16.5)
Elevated LDL-cholesterol (%)	51 (49.5)
High serum triglycerides (%)	26 (25)
Low HDL-cholesterol (%)	56 (54)
Microalbuminuria	
Males	14/22 (63.6)**
Females	31/81 (38.0)

Data are presented as either *n* (%) or mean±SD. Males versus females*P=0.03; **P=0.07. SD: Standard deviation, BMI: Body mass index, BP: Blood pressure, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, HBA1c: Glycated hemoglobin

were seen in another, and four patients had a new foot ulcer. Absent foot pulses and ischemic skin changes were seen in six patients. There was a loss of protective sensation among the fifth of the study population [Table 2].

Risk stratification

The diabetic foot risk stratification according to SIGN is summarized in Table 3. The frequency of selected risk factors and comorbidities in patients with different risk classes are shown in Table 4. All patients with active disease and 36% of patients with high risk have a duration of diabetes longer than 10 years. BMI >30 was common in all levels of risk and active disease [Table 4]. An elevated HbA1c occurred in all risk classes. Many patients had high serum lipid measurements, but these did not show a consistently linear trend between categories. Proliferative retinopathy was found with increasing frequency in increasing risk profiles [Table 4]. Rates of positive microalbuminuria increased with rising risk classes but not including patients with active disease. The frequency of tobacco smoking was low among various risk groups, and the four patients with active disease were nonsmokers.

Table 2: The frequency of abnormal physical examination findings in the feet

Findings	Frequency, *n* (%)
Tinea pedis infection	37 (35.9)
Bilateral hallux valgus deformity	13 (12.6)
Clawing of feet	8 (7.8)
Charcot joint	2 (1.9)
Amputated toes of one foot	1 (0.97)
Bilateral overriding toes	1 (0.97)
Skin callosity formation	69 (67)
Ingrowing nails	6 (5.8)
Onychomycosis	3 (2.9)
New foot ulcer	4 (3.9)
Absent pulses with ischemic skin changes	6 (5.8)
Loss of protective sensation	20 (19.4)
Loss of vibration sense	15 (14.6)
Loss of joint position sense	5 (4.9)

Table 3: Scottish Intercollegiate Guideline Network-based risk stratification by gender

Risk stratification	All (103) (%)	Males (22) (%)	Females (81) (%)
Low	59 (57.3)	10 (45.5)	49 (60.5)
Moderate	18 (17.5)	3 (14)	15 (18.5)
High	22 (21.4)	8 (36)	14 (17)
Active disease	4 (3.9)	1 (4.5)	3 (3.7)

Discussion

According to the Libyan national survey of risk factors for noncommunicable diseases, the estimated prevalence of diabetes in Libya is 16%.[11] To the best of our knowledge, this is the first study in Libya that determines the risk for diabetic foot ulcer among diabetic patients.

Most of the studied groups were wearing inappropriate shoes. According to one study, 39% of diabetic patients were wearing inappropriate shoes, and 43% of women reported wearing high heel shoe; in another study, 48.5% of women and 69% of men were wearing wrong size shoes.[12,13] The possible causes of lack of adherence to an appropriate foot wearing in our study would be most likely resulting from lack of education and the expensive cost of proper diabetic shoes.

The frequency of *Tinea pedis* is in agreement with the published literature.[14] Onychomycosis prevalence was lower than that in other studies.[14,15] Hallux valgus is the most universal deformity in this study, and its frequency is lower than the estimated prevalence of hallux valgus in the community (21%–70%).[16-18] The prevalence of Charcot joint in our study is similar to its prevalence in other studies (0.08%–7.5%).[19] Charcot's joint are been associated with increased risk of a diabetic foot ulcer.[20]

The evidence of peripheral vascular disease in our study is low in comparison with the literature.[4,21] The frequency might be underestimated because we use clinical assessment rather than the ankle-brachial index.

The most frequent neurological abnormality was the loss of protective sensation followed by the loss of vibration sense while the loss of joint position sense was the least common. A loss of protective sensation is an established predictor for diabetic foot ulcer. For instance, in one study loss of protective sensation was detected in 80% of patients with previous foot ulcer.[20]

Patients with moderate and high risk also had a high prevalence of elevated HbA1C, an elevated LDL-C, and low levels of HDL-C and obesity. They also had a high frequency of proliferative retinopathy and microalbuminuria, with a significantly higher prevalence of proliferative retinopathy among females.

Patients with low risk for diabetic foot according to SIGN have one or more of the other risk factors for diabetic foot ulcer when considering other risk stratification systems like Boyko *et al*.; making them still at increased risk for the development of diabetic foot ulcer.[6]

More than 60% of moderate, high risk and active disease in the studied group were obese particularly among females. Obese people can reach feet with difficulty, and they have an increased risk of callus formation and hallux valgus deformity. According to a large retrospective cohort study, diabetic foot ulcers were more prevalent among patients with BMI of more than 30.[22]

Tobacco smoking was not prevalent in the studied group. According to a survey of risk factors for noncommunicable diseases in Libya, the prevalence of smoking was more than 50%.[11] The small number of smokers in this study could be attributed to the fact that female patients in the study were more than males and smoking prevalence among Libyan females is low.

Table 4: Scottish Intercollegiate Guideline Network-based risk stratification by comorbidity and risk factors

Risk factors and comorbidity	Low (59) (%)	Moderate (18) (%)	High (22) (%)	Active disease (4) (%)
BMI >30	40/59 (68)	11/18 (61)	16/22 (73)	3/4 (75)
High HbA1c	35/59 (59)	10/18 (55.6)	19/22 (86)	4/4 (100)
High serum LDL-cholesterol	26/59 (44)	10/18 (55.6)	14/22 (63.6)	1/4 (25)
Low serum HDL-cholesterol	32/59 (54)	12/18 (66.7)	10/22 (45.5)	2/4 (50)
High serum triglycerides	15/59 (25)	7/18 (38.9)	4/22 (18)	0/4 (0)
Proliferative retinopathy	26/59 (44)	9/18 (50)	13/22 (59)	4/4 (100)
Microalbuminuria	22/59 (37)	11/18 (61)	14/22 (63.6)	1/4 (25)
Smoking	4/59 (6.7)	1/18 (5.5)	1/22 (4.5)	0/4 (0)

BMI: Body mass index, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, HBA1c: Glycated hemoglobin

Conclusions

We conclude that the patients in our study have many risk factors for diabetic foot ulcer, and nearly half of them were among moderate-risk, high-risk, and active disease categories. Development of diabetic foot screening clinics and diabetic foot care and education programs are urgently needed.

Author's contribution

NB: Concept and design of the study, acquisition of data, and data analysis. FN: Acquisition of data and revising article. Both authors approved the final version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Compliance with ethical principles

Ethical approval was granted by the Ethics Review Board of Benghazi Medical Centre, and consent was provided by all patients.

References

1. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y, *et al.* Global epidemiology of diabetic foot ulceration: A systematic review and meta-analysis †. Ann Med 2017;49:106-16.
2. Lavery LA, van Houtum WH, Ashry HR, Armstrong DG, Pugh JA. Diabetes-related lower-extremity amputations disproportionately affect blacks and Mexican Americans. South Med J 1999;92:593-9.
3. Amin N, Doupis J. Diabetic foot disease: From the evaluation of the "foot at risk" to the novel diabetic ulcer treatment modalities. World J Diabetes 2016;7:153-64.
4. Roaeid R, Kadiki O. Prevalence of long-term complications among type 2 diabetic patients in Benghazi, Libya. J Diabetol 2011;3:5.
5. Boulton A, Armstrong DG, Albert SF, Frykberg RG, Hellman R, Kirkman MS. Comprehensive foot examination and risk assessment. Diabetes Care 2008;8:1679-85.
6. Monteiro-Soares M, Boyko EJ, Ribeiro J, Ribeiro I, Dinis-Ribeiro M. Risk stratification systems for diabetic foot ulcers: A systematic review. Diabetologia 2011;54:1190-9.
7. Scottish Intercollegiate Guidelines Network Healthcare Improvement Scotland Gyle Square, 1 South Gyle Crescent Edinburgh EH12 9EB. Available from: http://www.sign.ac.uk/assets/sign116.pdf. [Last updated on 2017 Nov 29].
8. Baraz S, Zarea K, Shahbazian HB, Latifi SM. Comparison of the accuracy of monofilament testing at various points of feet in peripheral diabetic neuropathy screening. J Diabetes Metab Disord 2014;13:19.
9. Inlow S. A 60- Seconds foot exam for people with diabetes. Wound Care Canada 2004;2:10-1.
10. Riddle MC, Bakris G, Blonde L, Boulton A, D'Alessio D, Groot MD, *et al.* Standards of medical care in diabetes- 2018. Diabetes Care 2018;1:S1-159.
11. Beshyah SA. Beshyah SA. Non-communicable diseases and diabetes care guidelines: Epidemiology and call for collective action. February, 6th 2010, Dat Elmad Conference Hall Complex, Tripoli, Libya. Ibnosina J Med Biomed Sci 2010;2:142-8.
12. Gayle KA, Tulloch Reid MK, Younger NO, Francis DK, McFarlane SR, Wright-Pascoe RA, *et al.* Foot care and footwear practices among patients attending a specialist diabetes clinic in Jamaica. Clin Pract 2012;2:e85.
13. Paiva de Castro A, Rebelatto JR, Aurichio TR. The relationship between wearing incorrectly sized shoes and foot dimensions, foot pain, and diabetes. J Sport Rehabil 2010;19:214-25.
14. Legge BS, Grady JF, Lacey AM. The incidence of Tinea pedis in diabetic versus nondiabetic patients with interdigital macerations: A prospective study. J Am Podiatr Med Assoc 2008;98:353-6.
15. Akkus G, Evran M, Gungor D, Karakas M, Sert M, Tetiker T, *et al.* Tinea pedis and onychomycosis frequency in diabetes mellitus patients and diabetic foot ulcers. A cross sectional – Observational study. Pak J Med Sci 2016;32:891-5.
16. Benvenuti F, Ferrucci L, Guralnik JM, Gangemi S, Baroni A. Foot pain and disability in older persons: An epidemiologic survey. J Am Geriatr Soc 1995;43:479-84.
17. Dunn JE, Link CL, Felson DT, Crincoli MG, Keysor JJ, McKinlay JB, *et al.* Prevalence of foot and ankle conditions in a multiethnic community sample of older adults. Am J Epidemiol 2004;159:491-8.
18. Roddy E, Zhang W, Doherty M. Prevalence and associations of hallux valgus in a primary care population. Arthritis Rheum 2008;59:857-62.
19. Sohn MW, Stuck RM, Pinzur M, Lee TA, Budiman-Mak E. Lower-extremity amputation risk after Charcot arthropathy and diabetic foot ulcer. Diabetes Care 2010;33:98-100.
20. Frykberg RG, Belczyk R. Epidemiology of the Charcot foot. Clin Podiatr Med Surg 2008;25:17-28, v.
21. Mariam TG, Alemayehu A, Tesfaye E, Mequannt W, Temesgen K, Yetwale F, *et al.* Prevalence of diabetic foot ulcer and associated factors among adult diabetic patients who attend the diabetic follow-up clinic at the university of Gondar referral hospital, North West Ethiopia, 2016: Institutional-based cross-sectional study. J Diabetes Res 2017;2017:2879249.
22. Al-Rubeaan K, Al Derwish M, Ouizi S, Youssef AM, Subhani SN, Ibrahim HM, *et al.* Diabetic foot complications and their risk factors from a large retrospective cohort study. PLoS One 2015;10:e0124446.

Reviewers:	Editors:
Abbas Mansour (Basrah, Iraq)	Salem A Beshyah (Abu Dhabi, UAE)
Mahir Jallo (Ajman, UAE)	Elmahdi Elkhammas (Colmbus, OH, USA)