Prevalence of Diabetic Foot Ulcer and its Associated Risk Factors among Diabetic Patients in Jordan

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Abstract

Objectives: The objectives of this study were to assess the prevalence of diabetic foot ulcers and their risk factors among patients attending the National Center for Diabetes, Endocrinology, and Genetics (Amman, Jordan).

Materials and Methods: A systematic random sample of 1,000 diabetic patients was selected from patients attending the diabetes clinic at the National Center for Diabetes, Endocrinology, and Genetics (Amman, Jordan). Vascular, neurological, musculoskeletal, and ulcer risk categories were all assessed.

Results: There were 49% males in the sample. The mean age of the sample was 52 years, and the mean duration of diabetes was 9.7 years. Diabetic foot ulcer prevalence was 4.6%, sensory neuropathy 14.9%, lower limb ischemia 7.5%, and amputation 1.7%. Ulceration was associated mainly with the male gender, neuropathy, and increased duration of diabetes.

Conclusions: Future efforts should be directed toward educating both healthcare professionals and patients about proper foot care. Community based studies are also necessary to determine the actual prevalence of diabetic foot complications.

Keywords: Diabetic foot ulcer, diabetes, Jordan, neuropathy.

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Introduction

Diabetic foot ulcers are a major cause for diabetic foot infection.[1,2] About 10%–30% of diabetic patients with a foot ulcer will eventually progress to an amputation.[1, 3] The prevalence of foot ulcers among diabetic patients ranges from 2% to 12%.[4,5] In addition, the lifetime risk of a diabetic person developing a foot ulcer could be as high as 25%.[6] The financial burden is also extremely high, with the cost of treating a single foot ulcer in the USA estimated at $28,000 over a 2-year period.[6] The main risk factors for diabetic foot ulcers include sensory neuropathy, lower limb ischemia, and trauma. However, most of these risk factors are preventable.[6]

In the year 2010, diabetes was expected to affect

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285 million people worldwide and is expected to affect 439 million by the year 2030.[7] Middle Eastern countries have a high prevalence of diabetes; in 2010, five of the top ten countries with the highest diabetes prevalence in the adult population will be Middle Eastern and Arabic countries. These five countries and their corresponding prevalence rates are: United Arab Emirates (18.7%), Saudi Arabia (16.8%), Bahrain (15.4%), Kuwait (14.6%), and Oman (13.4%).[7] Likewise, Jordan has a high prevalence of diabetes with estimates reaching 17.1 % in one recent report.[8] This high regional prevalence of diabetes will certainly lead to high rates of foot ulcers along with increasing morbidity and costs unless urgent preventive measures are taken.

Data on the epidemiology of diabetic foot ulcers in the Middle East including Jordan is sparse; an earlier study in Jordan in 2001 looking at lower limb amputation in diabetics showed a prevalence of foot ulcers of 4%.[9] A similar rate was reported in a diabetes clinic-based study in Iran.[10] In Bahrain, a nationwide primary care diabetes clinic-based study among 1477 patients found the prevalence of foot ulcers to be 5.9%, with neuropathy and peripheral vascular disease (PVD) identified as the major risk factors.[11]

This study investigates the prevalence of diabetic foot ulcers and its associated risk factors among diabetic patients attending the National Center for Diabetes, Endocrinology, and Genetics (NCDEG) at the University of Jordan (Amman, Jordan).

Methods

Sample and Data Collection

This is a cross sectional screening study conducted at the NCDEG (Amman, Jordan). The center is affiliated to the University of Jordan and offers multidisciplinary medical services for diabetic patients with several specialized clinics including diabetes, cardiology, nephrology, ophthalmology, and a specialized foot care clinic. A systematic random sample of 1,000 diabetic patients was selected from patients attending the diabetes clinic at the NCDEG during the period from 15th of August till 31st of December 2006. The center served around 4,000 diabetic patients during the year 2006. Screening was performed daily by a podiatric nurse practitioner (AA). The diagnosis of diabetes was ascertained by reviewing medical records for laboratory glucose values and for receipt of insulin and/or oral hypoglycemic agents.

A standardized form was used to record data obtained from reviewing the medical records, interviewing, and examining the patients. Data were collected on age, gender, weight, height, type and duration of diabetes, most recent three HbA1C values, treatment modality, smoking status, and hypertension. We also assessed vascular, neurological, musculoskeletal, dermatological, nail and foot wear conditions, and ulcer risk category.

Definitions

Neuropathy diagnosed by a monofilament test was defined as an absent sensation at any one site on either foot, performed with a 10-g Semmes-Weinstein monofilament on four plantar sites on the forefoot, the great toe, the base of the hallux, and the third and fifth metatarsals.[12] Lower extremity vascular disease was defined as an absent tibialis posterior pulse, with or without other signs or symptoms, or an absent dorsalis pedis pulse with at least one lower extremity vascular sign or symptom as defined below.[13] Lower extremity vascular signs and symptoms included claudication, edema, and pale and mottled skin. A foot ulcer was defined as a full thickness skin break at least to Wagner stage 1, from the distal to the malleoli. Deformities were defined as the presence of any of the following structural abnormalities in one or both feet: hammer toes, claw-toes, hallux valgus, prominent metatarsal heads, status after neuro-osteoarthropathy, amputations, or other foot surgery. Limited joint mobility was defined as stiffness or restricted range of motion of a joint in one or both feet.

The range of motion was evaluated by moving the ankle, the subtalar joint, the metatarsal joints, and the phalangeal joints through their normal ranges of motion, and determining whether there is any pain, restriction to the range of motion, or crepitus.[14]

Skin assessment included evaluation for quality (normal, dry, thin, shiny, and atrophy of the plantar fat pad), color (normal, red, pale and mottled, or blue and cyanotic), and temperature (normal, cold, warm, and hot). Other recorded skin abnormalities included blisters, cellulitis, dilated veins, fissures, swelling, calluses, corns, dermopathy, macerations, edema, verruca, and tinea pedis.

Ill-fitting foot wear was defined as the presence of one or more of the following: too tight, or too wide, high heel, poor quality or hard leather, or soft insole for patients with neuropathy.

Risk categories were defined as: grade 0= No neuropathy present; grade 1= Neuropathy without deformity or history of ulceration; grade 2= Neuropathy with deformity or peripheral vascular disease; and grade 3= History of ulcer or amputation.[15]

Wagner ulcer classification system was defined as: grade 0= No ulcer, but high-risk feet (bony prominences, callus, claw toes, etc.); grade 1= Superficial full-thickness ulcer; grade 2= Deep ulcer, may involve tendons, no bone involvement; grade 3= Deep ulcer with bone involvement, osteomyelitis; grade 4= Localized gangrene; grade 5= Gangrene of whole foot.[16]

Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences software (SPSS), version 11.5. Data were described using means and standard deviation for continuous variables and frequencies and percentages for categorical variables.

Percentages were compared using a chi-square test. Multivariate analysis was conducted using binary logistic regression analysis to determine the factors associated with diabetic foot ulcers. A p-value of less than 0.05 was considered statistically significant.

Results

The study included a total of 1,000 diabetic patients (490 males and 510 females). Diabetes type 1 and type 2 were present in 13% and 87% of patients, respectively. The mean of the patients' ages was 52 years (SD ± 17). The mean duration of diabetes was 9.7 years (SD ± 7.3).

The mean body mass index was 32.3 kg/m^2 (SD±7.3), and the mean HBA1C level was 8.2% (SD± 1.6). Table (1) shows the demographic and clinical characteristics of the study participants.

Of those examined, 4.6% had foot ulcers, 7.5% had lower limb ischemia, 14.9% had peripheral sensory neuropathy, and 1.7% had amputations with 35% of the amputations either above or below the knee. Of the ulcers, 26% were advanced and belonged either to Wagner grade 2 (20%) or grade 3 (6%). Table (2) shows the distribution of risk factors for diabetic foot ulcers among the study population and in patients with foot ulcers.

Poor foot wear condition was present in 79%, calluses in 43.7%, fissures in 26.5%, and tinea pedis in 23%. Table (3) shows the prevalence of local foot complications.

In the multivariate analysis (Table 4), the only factors that were associated with a foot ulcer were gender, duration of diabetes, and sensory neuropathy. Males were almost twice more likely to have a foot ulcer compared to women (OR=2.17 (95.0% CI: 1.10, 4.27)).

An increased duration of diabetes was significantly associated with the increased odds of having a foot ulcer. Peripheral sensory neuropathy to 10 gm monofilament was significantly associated with increased odds of having a foot ulcer (OR=10.78 (95.0% CI: 5.00, 23.34)).

Table (1): Demographic and clinical characteristics of the study population.

Characteristic	No. patients (N=1000)	Percent (%)
Male – no. (%)	490	49
Female – no. (%)	510	51
Age (yr)		
Mean ± SD	53 ±17	
≤ 20	106	10.6
21-40	50	5
41-50	156	15.6
51-60	333	33.3
61-70	281	28.1
>70	74	7.4
Weight – Kg (Mean ± SD)	78.4 ± 18.6	
Height – cm (Mean ± SD)	161 ± 10.9	
BMI- no. (%)		
< 25	192	19.2
25-30	337	33.7
>30	471	47.1
DM Type 1 – no. (%)	129	12.9
DM Type 2 – no. (%)	871	87.1
Most recent three HbA1C values		
Mean	8.2	
Range	4.5-17.6	
HbA1C <7 %	227	22.7
HbA1C 7-7.9%	261	26.1
HbA1C 8-9.9%	359	35.9
HbA1C >10%	153	15.3
Treatment – no. (%)		
Diet alone	30	3
Oral agents	500	50
Insulin alone	145	14.5
Oral agent + Insulin	323	32.3
Hypertension – no. (%)	589	58.9
Smoking– no. (%)		
Non-smoker	701	70.1
Current smoker	197	19.7
Ex-smoker	102	10.2

Table (2): Distribution of risk factors among the study population and in patients with ulcers.

	No. of patients	Ulcers n (% of ulcers among patients in the specific group)
Age		
≤ 40	50	0
41-50	156	5 (3.2)
51-60	333	23 (6.9)
61-70	281	14 (5.0)
>70	74	4 (5.4)
p value		0.029
Gender		
Male	490	31 (6.3)
Female	510	15 (2.9)
p value		0.008
Type of DM		
Type 1	129	1 (0.8)
Type 2	871	45 (5.2)

p value		*0.012*
Duration of DM		
<5	*363*	*1 (0.3)*
5-10	*286*	*2 (0.7)*
>10	*351*	*43 (16.0)*
p value		*0.000*
Mean of the most recent three HbA1C values		
HbA_{1C} <7	*250*	*3 (1.2)*
HbA_{1C} >7	*750*	*43 (5.7)*
P value		*0.001*
Treatment		
Diet	*30*	*1 (3.3)*
Oral agent	*500*	*8 (1.6)*
Insulin	*145*	*11 (7.6)*
Insulin + oral agent	*323*	*25 (7.7)*
p value		*0.000*
Total	*1000*	*46*
Prevalence %		*4.6 %*

Table (3): Prevalence of local foot complications, amputation, risk category, and Wagner classification among the study population.

local foot complications	***N***	***Percent (%)***
Fissures	*265*	*26.5*
Deformity	*340*	*34*
Limited joint mobility	*127*	*12.7*
Calluses	*437*	*43.7*
Cellulitis	*26*	*2.6*
Tinea pedis	*230*	*23*
Blisters	*13*	*1.3*
Ingrown toe nails	*31*	*3.1*
Poor foot wear condition	*789*	*78.9*
Amputation		
Toes	*8*	*0.8*
Foot	*3*	*0.3*
Below knee	*3*	*0.3*
Above knee	*3*	*0.3*
Edema	*18*	*1.8*
Risk category		
Low	*590*	*59*
Moderate	*247*	*24.7*
High	*89*	*8.9*
Previous ulcer	*56*	*5.6*
Wagner classification		
Grade 0	*73*	*7.3*
Grade 1	*34*	*3.4*
Grade 2	*9*	*0.9*
Grade 3	*3*	*0.3*

Discussion

This large, diabetes center-based study in Jordan showed that the prevalence of diabetic foot ulcers is 4.6%. Although accurate comparisons are difficult to make since populations and definitions of foot conditions vary across different studies, this result is similar to other reports from Canada, Greece, and Iran.[5] It is also similar to a previous study performed in Jordan in

2001.[9] However, contrary to the present study, the previous study did not look into the risk factors for diabetic foot ulcers. Here, ulcers were significantly associated with the male gender, increasing duration of diabetes, and sensory neuropathy. These results are in accordance with earlier studies.[6]

Lower limb ischemia was present in a relatively low rate of 7%; this low rate could be due to the use of a definition with low sensitivity. Current diabetes guidelines are recommending that the ankle brachial index be considered for screening peripheral PVD since many patients can be asymptomatic.[17, 18] Nevertheless, similar low rates of PVD were observed in developing countries; a comparative study of diabetic patients with foot lesions in Germany, India and Tanzania found that around 80% of the patients in each center had peripheral neuropathy, but only 12% and 13% in Tanzania and India, respectively, had PVD compared to 48% in Germany.[19, 20]

Peripheral sensory neuropathy evaluated by the 10-g Semmes-Weinstein monofilament was present in around 15% of the study patients and in 71% of those with foot ulcers. This is similar to earlier studies which reported prevalence rates between 70 -100% in patients with ulcers.[6] Nonetheless, we still might have underestimated the prevalence of peripheral neuropathy since the 10-g monofilament, although widely used, might not be the most sensitive test for screening diabetic neuropathy.[21, 22]

We also found a high prevalence of preventable local foot complications particularly ill-fitting shoes (79%), calluses (43%), tinea pedis (23%), and fissures (26.5%). These figures indicate the need to improve local foot care of our patients.

Our population showed a poor glycemic control with around 77% of the patients having the mean of the most recent three HBA1C > 7%. Obesity was also common with 50% of the patients having BMI > 30%. Type 1 diabetes was present in 13% of the patients. These characteristics are suggestive of a population with high rates of underlying complications and possibly leading to an overestimation of a foot complication. Although this was a large study, it had two main limitations. First, this was an advanced diabetes center based study. Thus, it might have overestimated the prevalence of ulcers and risk factors. Second, the lower limb ischemia might have been underestimated due to the use of a definition with low sensitivity.

Conclusion

We showed that diabetic foot ulcers are present in 4.6% of patients in our center. Ulceration was associated mainly with the male gender, neuropathy, and increased duration of diabetes. Future efforts should be directed toward educating both the healthcare professionals and patients about proper foot care. Community based studies are also necessary to determine the actual prevalence of diabetic foot complications.

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معدل الانتشار لتقرحات القدم السكرية والعوامل المساعدة عند مرضى السكري في الأردن

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الملخص

الأهداف: تقييم معدل الانتشار لتقرحات القدم والعوامل المساعدة عند مرضى السكري في الأردن.

طريقة البحث: أخذت الدراسة عينة منهجية عشوائية من 1000 مريض سكري يراجعون المركز الوطني للسكري والغدد الصم والوراثة (عمان، الأردن) وتم تقييم كل من الدورة الدموية، الجهاز العصبي، والحركي في القدم مع قياس نسبة الإختطار الخاص بالقرحة.

النتائج: كانت نسبة الذكور 49% ومعدل الأعمار 52 عاما. بلغ معدل الانتشار لتقرحات القدم 4.6%، اعتلال الأعصاب 14.9%، ضعف التروية 7.5%، والبتر 1.7%. كانت التقرحات مرتبطة مع الذكور، اعتلال الاعصاب، وطول مدة الإصابة بالسكري.

الاستنتاجات: الجهود المستقبلية يجب أن تركز على تثقيف كل من الكادر الصحي والمرضى حول العناية بالقدم السكرية، بالإضافة للقيام بدراسات للوقوف على نسب الانتشار لتقرحات القدم السكرية على مستوى المجتمع.

الكلمات الدالة: القدم السكرية، اعتلال الأعصاب، الأردن.