Prevalence and predictors of diabetic foot syndrome in type 2 diabetes mellitus in Jordan

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ABSTRACT

Objective: To detect feet changes and to identify risk factors leading to amputation among type 2 diabetics.

Methods: A total of 1142 patients with type 2 diabetes mellitus; 595 males (52%), and 547 females (48%) were seen between January and December 2001 at the National Center for Diabetes, Endocrinology, and Genetics (NCDG) Amman, Jordan. The mean age was 56.1 years (SD=10.2) and the mean duration of diabetes was 9 years (SD=7.1). All patients had a complete medical assessment including history, physical examination, glycosylated hemoglobin (HbA1c) (the mean of the last 4 readings) and microalbuminuria. Statistical analysis were performed to identify significant risk factors leading to amputation using Epi info, version 6 software

Results: Mean HbA1c was 7.4% (SD=1.4). The prevalence of hypertension was 52%, retinopathy 45% and microalbuminuria 33%. Impaired vibration, position and protective sense were found in 19%, 13%, and 18%. The prevalence of all amputations was 5%. The following were strong predictors of amputation; duration of diabetes (P= 0.04), smoking (P=0.01), microalbuminuria (P=0.02), retinopathy (P=0.008), legs hair loss (P=0.003), neurological deficit (P=0.0001), ulceration (P=0.00001) absent dorsalis pedis (P=0.0006) and insulin therapy (P=0.0001). The rate of amputation was directly proportional to high HbA1c ≥ 8% (P=0.01). Age and gender were not found to have an impact on prevalence of amputation.

Conclusions: Prevalence of amputation correlates with duration of diabetes, poor glycemic control, smoking, neurological impairment, peripheral vascular disease and microalbuminuria.

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Diabetic foot syndrome refers to foot infection, ulceration or destruction of deep tissues associated with neurological abnormalities, or both and various degrees of peripheral vascular insufficiency. Amputation of lower extremities is a frequent complication of uncontrolled diabetes, which is often due to circulatory and neuropathic complications.[1,2] Neuropathy is predominantly sensory characterized by diminution of pain, vibration, and position sense.[3] Prior studies reported increased risk for lower extremity amputation in diabetics with advanced age, male gender, black race, and history of smoking.[4-6] It has also been reported that with proactive education, proper foot care, and identification of risk factors, many of these amputations can be avoided.[7,8] The establishment of National Center for Diabetes, Endocrinology, and Genetics (NCDEG), in 1996, which attracts diabetic patients from all over Jordan, provided an opportunity to study this serious complication among our patients. The purpose of this paper is to report foot changes among

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patients with type 2 diabetes mellitus. To identify factors associated with amputation among those patients with type 2 diabetes mellitus.

Methods. All patients with type 2 diabetes mellitus that attended the NCDEG during the period January through to December 2001 and seen by the principle investigator (1142 patients) were included in the study. Physical examination of each patient included assessment of the peripheral pulses of the lower limbs, neurological examination, dermatological inspection, fundoscopy, height, weight, and blood pressure measurement. Hypertension was defined as a systolic blood pressure ≥ 140 mm Hg and diastolic blood pressure ≥90 mm Hg, or both or being on antihypertensive medication.

Laboratory assessment included. 1. Glycosylated hemoglobin (HbA1c) measured by high performance liquid chromatography. The mean of the last 4 readings was used. (Normal value 4.2-6.2%) 2. Microalbuminuria measured by immunoturbidometric assay. A level >20 mg/24 hour was considered positive. Exclusion criteria included patients with gestational diabetes mellitus and amputation due to trauma or conditions other than diabetes. An informed verbal consent was obtained from all study subjects. Statistical analysis was performed using Epi Info, Version 6 software. Observed differences were assessed for statistical significance using the chi-square test.

Results. A total of 1142 diabetic patients were included in the study. Males accounted for 52% of patients. The mean age was 56.1 years (SD=10.2). The mean duration of diabetes was 9 years (SD=7.1) and the mean body mass index was 30.3 kg/m^2 (SD=4.9). The mean HBA1c level was 7.4% (SD=1.4). The prevalence rates of hypertension, retinopathy, microalbuminuria and all diabetic foot elements are shown in **Table 1**. Common foot changes included dryness of skin, fissuring, callus formation, and tinea pedis. Impaired vibration, position, and protective sensations were observed in 19%, 13%, and 18% of patients. Amputation of any type was observed in 5% of patients. The prevalence of amputation by a number of variables among diabetic patients is shown in **Table 2.** The rate of amputation increased significantly with increased duration of diabetes (P=0.04), Smoking (P=0.01), microalbuminuria (P=0.02), retinopathy (P=0.0008), hair loss (P=0.0003), neurological deficit (P=0.0001), absent dorsalis pedis pulses (P=0.0006), ulceration (P=0.00001), and insulin therapy (P=0.0001). The prevalence of amputation was higher among patients with a HBA1c level ≥8% (P=0.01. There were no differences in the prevalence of amputation by gender and age.

Discussion. The present study is the first in Jordan regarding feet manifestations of diabetes mellitus. Amputation of toes, feet, or legs are among the most

Table 1 - Sociodemographic and clinical characteristics of diabetic patients (N=1142).

Variables	n	(%)
Sex		
Male	595	(52)
Female	547	(48)
Age (Mean=56.1 years, SD=10.2)		
20-29 years	9	(1)
30-39 years	51	(4)
40-49 years	198	(17)
50-59 years	430	(38)
≥60 years	444	(39)
Duration of diabetes mellitus (Mean=9 years, SD=7.1)		
1-9 years	595	(52)
10-19 years	362	(32)
>20 years	120	(11)
Presence of hypertension		
Yes	599	(52)
HbA1c (Mean=7.4%, SD=1.4)		
<7	426	(37)
7-8	263	(23)
>8	384	(34)
Type of treatment		
Oral	676	(59)
Insulin	239	(21)
Both	140	(12)
Diet alone	54	(5)
Presence of retinopathy		
Yes	519	(45)
Presence of microalbuminuria		
Yes	377	(33)
Dryness of the skin	402	(35)
Hair loss	379	(33.4)
Fissuring	198	(17)
Callus	227	(20)
Impaired vibration sense	212	(19)
Impaired position sense	152	(13)
Absent protective sensation (monofilament)	205	(18)
Peripheral pulses		
Absent dorsalis pedis	144	(13)
Absent posterior tibial	139	(12)
Presence of ulceration	45	(4)
Toes amputation	42	(4)
Foot amputation	10	(1)
Amputation below knee	3	(0)
All amputations	53	(5)

HbA1c - glycosylated hemoglobin
Variation in total due to missed numbers
Age range 20-≥60 years
Duration of diabetes mellitus range 1->20 years
HbA1c range <7->8

Table 2 - Prevalence of amputation by selected variables among type 2 diabetes mellitus patients (N=1142).

Variable	n and (%) of patients with amputation		p-value
Sex			
Male	29	(3)	0.8
Female	24	(2)	
Age group			
20-39	3	(0)	
40-59	25	(2)	0.54
60+	24	(2)	
Duration of diabetes mellitus			
1-9 years	22	(2)	
10-19 years	23	(2)	0.04
20+	8	(1)	
Microalbuminuria			
Present	31	(3)	0.02
Absent	21	(2)	
Retinopathy			
Present	37	(3)	0.0008
Absent	16	(1)	
Hypertension			
Present	11	(1)	0.87
Absent	42	(4)	
Dryness of the skin			
Present	25	(2)	0.09
Absent	28	(2)	
Smoking			
Yes	20	(2)	0.01
No	32	(3)	
Fissure			
Present	14	(1)	0.37
Absent	48	(4)	
Callus			
Present	12	(1)	0.98
Absent	40	(4)	
Hair loss			
Present	28	(2)	0.0003
Absent	25	(2)	
Neurological deficit			
Present	30	(3)	0.0001
Absent	23	(2)	
Dorsalis pedis			
Present	34	(3)	0.0006
Absent	19	(2)	
Ulceration			
Present	14	(1)	0.00001
Absent	39	(3)	
Insulin treatment			
Yes	21	(2)	0.0001
No	31	(3)	
HbA1c <8	25	(2)	0.01
≥8	28	(2)	

HbA1c - glycosylated hemoglobin

serious complications of the disease. Studies of the incidence of lower limb amputation showed extreme variability between different areas and ethnic groups.[9,10] Studies on the incidence of lower limbs amputation in diabetics are few, many of which are retrospective, and can at most examine age, sex and race as risk factors.[6,11] Other studies were prospective in nature and identified a number of risk factors for amputation including black race, duration of diabetes, hypertension, smoking, low educational level,[12] retinopathy, fasting plasma glucose and use of insulin were found significant in the Oklahoma Indian Diabetes Study.[13] History of ulceration, proteinuria, elevated HbA1c, male gender, duration of diabetes and retinopathy were found by Moss et al[14] to be of significance in predicting foot amputation. Our data showed a prevalence of amputation of 5%. Correlations with amputation included a long duration of diabetes, presence of microalbuminuria, retinopathy, neuropathy, ischemia, ulceration, smoking, and insulin therapy that are in agreement with a number of previous studies.[2,11] To our knowledge, hair loss was not previously reported to correlate with amputation, it was found to be of significance denoting loss of trophycity and peripheral ischemia. Lack of control as evidenced by a high level of HBA1c (≥ 8%) was a strong predictor of amputation among our patients. Male gender, increasing age and hypertension were identified in some studies as risk factors of amputation.[15] However, consistent with our findings, other investigators found no such associations with increasing age and hypertension.[14,15] Many of the correlates of amputation in this study may be potentially modifiable. Tight control of blood sugar; early detection and treatment of proteinuria, vascular, and neurological deficits; cessation of smoking; and improving foot care in diabetic patients to prevent infection and ulceration may provide effective approaches for the prevention of amputation.

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