Common foot examination features of 247 Iranian patients with diabetes

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ABSTRACT

Background: Iran is a Middle Eastern country with a 70 million population. There are 3 million Iranians with diabetes mellitus (DM) and there is a high incidence of non traumatic amputation in this population. Amputation is often preceded by foot deformity or ulceration. We evaluated the routine foot examination of persons with diabetes (PWD) attending an outpatient Diabetic Clinic to identify the clinical characteristics that might be early warning signs of individuals at a high risk of developing a foot ulcer or having a subsequent non traumatic amputation.

Methods: A prospective, descriptive, clinic-based study was conducted on 247 patients with diabetes mellitus in 2005. The objectives of the study were to define the abnormal features of the foot examination in PWD which could be risk factors for ulceration or amputation.

Results: The mean age of patients with diabetes was 52 ± 12. The prevalence of callus in the enrolled patients was 12% and heel fissures were noted in 50%. There was a significant relationship between callus formation and the absence of tibialis posterior pulse (odds ratio 5), the presence of the hammer toe deformity (odds ratio 4), and foot ulceration (odds ratio 3). The prevalence of foot ulcers in PWD was 4%.

Conclusion: A diabetic screening program identifying callus formation, absent pulses, and hammer toe are important early signs of individuals at an increased risk for foot ulcers. This program will facilitate early treatment to decrease the loss of limbs.

Key words: Case studies • Diabetic foot ulcer • Iran • Prospective • Wound

INTRODUCTION

Diabetes is a common metabolic disorder affecting 4·2% of world population (1). Diabetes prevalence in the Middle East is among the highest in the world including 24·5% in United Arab Emirates, 18·2% in Qatar, 16·4% in Kuwait and 9·6% in Saudi Arabia (2). The high prevalence of diabetes mellitus (DM) could be due to rapid economic development and tremendous changes in life style that have resulted in less exercise, more smoking, unhealthy nutrition and increased obesity.

Patients with diabetes commonly develop foot complications including neuropathy, Charcot arthropathy, infection, vascular disease and ulceration. Foot ulcers are common and occur in up to 15% of persons with diabetes (PWD) (3,4). The high incidence and recurrence rate of foot ulcers in PWD results in increased health care costs and lost productivity (3,5). Individuals with diabetes have up to 46-fold greater risk of lower extremity amputations than individuals without diabetes (6). The International Diabetes Federation has documented that every 30 s a lower limb is lost somewhere in the world due to diabetes (5). Regular inspection and early treatment is one

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Key Points

- the high prevalence of diabetes mellitus (DM) could be due to rapid economic development and tremendous changes in life style that have resulted in less exercise, more smoking, unhealthy nutrition and increased obesity
- foot ulcers are common and occur in up to 15% of persons with diabetes
- individuals with diabetes have up to 46-fold greater risk of lower extremity amputations than individuals without diabetes

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Key Points

- regular inspection and early treatment is one of the most effective mechanisms to prevent these devastating diabetic foot complications
- the prevalence of diabetes in Iran is increasing but we have very limited information on diabetic foot complications
- the objective of this study was to document early foot changes that may predict an increased risk of future ulcer formation in a diabetic population
- 247 patients with DM attending the diabetes center of the University of Kerman were screened
- the patients were examined by a dermatologist and a questionnaire was filled out by a physician treating persons with diabetes
- there was a significant relationship between the presence of callus and ulcer formation, absence of tibialis posterior pulse and the hammer toe deformity

of the most effective mechanisms to prevent these devastating diabetic foot complications. Although there is an obvious increase in diabetic foot care awareness, there are tremendous gaps in routine foot evaluations. It is important to address these deficiencies with preventive strategies around the world including African and Asian countries with the greatest increased prevalence of type II DM (5–7).

DIABETES IN IRAN

According to the epidemiological studies 14·5–22·5% of the Iranian population over the age of 30 has an impaired glucose tolerance (IGT) test (8). The prevalence of diabetes in Iran is increasing but we have very limited information on diabetic foot complications. In a previously published Iranian epidemiological study, three million people were affected with DM and with the process of urbanisation, the relative percentage of PWD is increasing (9,10).

Data on foot amputation rates in PWD are very difficult to find and the only published information is from the hospitalised patients. In these individuals, amputations occurred in over 30% of individuals admitted with a foot ulcer and diabetes. A previous Iranian study revealed that approximately 50% of PWD are not aware of their disease (3,4). A diabetic center in Isfahan reported the results of a 4000-patient survey of persons with type II diabetes and identified active foot ulcers in 2·5% of the PWD (11). This incidence is lower than other reports and we wanted to obtain further data from a different Iranian setting. It is extremely important to identify individuals at a high risk of diabetic foot complications to lower the incidence of preventable amputations. The prevention of ulcer recurrence is another important goal. Recurrence rates range from 28% in 12 months to up to 100% at 40 months (12). Early detection and appropriate management of high risk patients is essential to reduce major morbidity and mortality. The objective of this study was to document early foot changes that may predict an increased risk of future ulcer formation in a diabetic population.

METHODOLOGY

An office-based cross-sectional study was conducted in 2005; 247 patients with DM attending the diabetes center of the University of Kerman were screened. The clinic services most patients living in Kerman province. The sampling was consecutive and the data were recorded from direct history and physical examination. The patients were examined by a dermatologist and a questionnaire was filled out by a physician treating persons with diabetes.

The diagnosis of diabetes was based on World Health Organisation criteria (presence of classic symptoms of diabetes plus random glucose $\geq$ 11·1 mmol/l or fasting blood glucose $\geq$ 7·0 mmol/l) (8). The demographic data included age, sex and occupation with the clinical data including family history of DM and type of diabetes associated medical complications (stroke, eye changes, nephropathy, etc). The last recorded blood sugar was also documented.

RESULTS

Most of the patients (Table 1) were female (77%) and had type II DM (94%). The age range was from 16 to 85 years, with mean age of 52 $\pm$ 12. The mean duration of diabetes in our patients was 7 $\pm$ 5 years and the mean fasting blood sugar was 11·55 $\pm$ 4·4 mmol/l. The prevalence of each clinical manifestation and diabetes related complications are outlined in Table 2. The prevalence of callus was 21% with common sites including the metatarsal head region (23 patients), plantar aspects of great toe (18 patients) and other locations (13 patients). Ten patients (4%) had an open foot ulcer and 1% of patients had a previous history of amputation. There was a significant relationship between the presence of callus and ulcer formation, absence of tibialis posterior pulse and the hammer toe deformity (Figure 1). There was no significant relationship between callus formation in different sexes or with the type of diabetes.

Table 1 The demographic characteristics of patients with diabetes mellitus

Demographics	Number	%
Sex		
• Female	191	77
• Male	56	23
Type of Diabetes		
• DM(type II)	233	94
• DM (type I)	14	6
Family history of diabetes		
• Yes	134	54
• No	113	46

Table 2 The prevalence of complications in diabetic patients

Diease	No	%	Disease	No	%
Symptoms			Callus	51	21
Numbness	181	73	Ulcer	10	4
Burning sensation	151	61	Dermopathy	2	1
Crawling	124	50			
Tingling	118	48	Deformity		
			Prominent	2	1
Skin			metatarsals Charcot	0	0
			joint	42	17
Heel crack	122	50	Claw toe	21	9
Dry skin	84	34	Hammer toe		
Thickened nail	73	30	Other complications		
Nail Discoloration	26	11		48	19
Onycholysis	17	7	Eye	14	7
In growing toe nail	2	1	Stroke	89	33
			Heart problem	3	1
			Varicosity of leg veins		

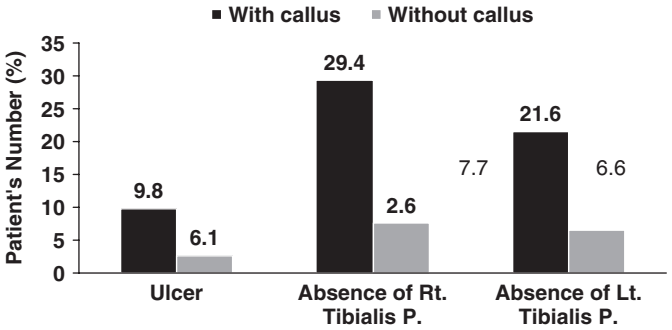

Figure 1. Relationship between callus formation and other clinical findings.

DISCUSSION

The present study documented the foot examination of 247 diabetic patients. Most of the patients were female (77%) because the Diabetic Clinic is scheduled in the morning when majority of male patients are at work. Previous epidemiological studies on the prevalence of diabetes have been published from other parts of Iran with a mean age of 47 ± 6 years in Tehran (8). This finding agrees with previous incidence study in Isfahan with a mean age of 49 years (13). The higher age in present study (52) could be because of the sex discrepancy in sampling and the urban clinic attendee population.

Correcting factors which delay healing in PWD combined with evidence informed clinical practice can improve outcomes (14). There was an absent dorsalis pedis pulse in 37% (91 patients) of the patients in this survey and these individuals are at a greater risk of amputation because of ischemia. The vast majority of these patients had callus formation as well (72 patients), indicating the combined neuroischemic changes that would increase the amputation risk even further. These patients need immediate non invasive screening to see if there are proximal bypassable or dilatable lesions that can improve the perfusion to the foot. The ankle brachial pressure index (ABPI) can be performed at bed side by a hand held Doppler but the results may be falsely high with non compressible or calcified vessels and toe pressures along with transcutaneous oxygen saturation may be a better screening test prior to full segmental duplex Doppler and angiograms for patients with potentially treatable lesions.

The presence of heel cracks in 50% of young population is very concerning because this break in the epidermal barrier can serve as a route of infection that may be limb threatening. The climate in most parts of Iran is dry and it is customary for some Iranian people to walk barefoot at home (15). In addition, local traditional treatments that are untested and not

Key Points

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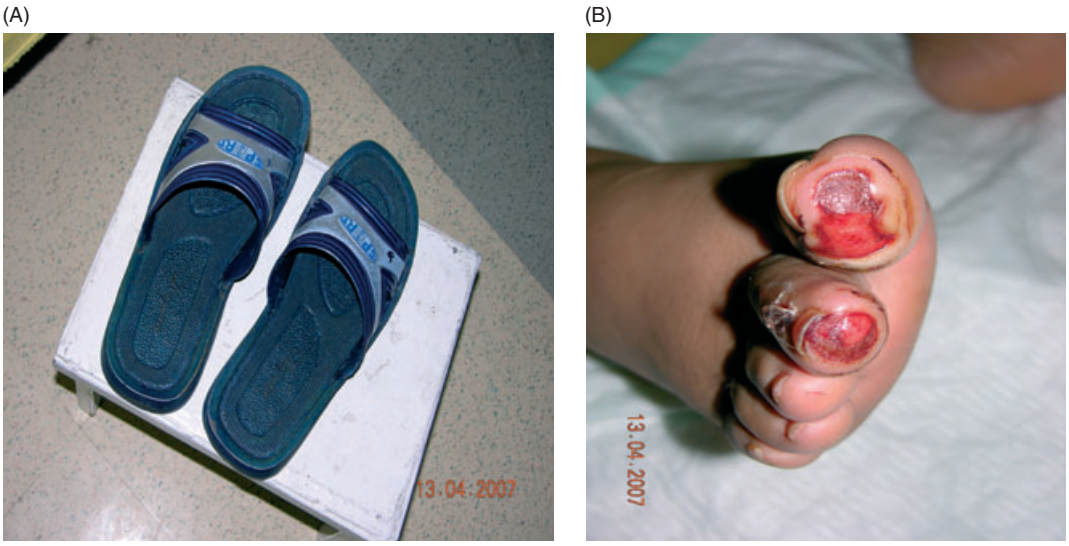

Figure 2. Diabetic foot ulcer triggered by improper foot wear.

Key Points

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- the climate in most parts of Iran is dry and 1it is customary for some Iranian people to walk barefoot at home
- in addition, local traditional treatments that are untested and not scientifically sound are often applied to foot ulcers
- there is a lack of health care professional training to remove callus and to redistribute increased plantar pressure
- in Iran, monofilament testing for loss of protective sensation has not been incorporated into routine clinical practice
- peripheral neuropathy is often diagnosed with loss of sensation by history asking about the symptoms of numbness, tingling, crawling, shooting, stabbing, or burning
- these symptoms may appear some time after the very sensitive monofilament test would have been positive and alerted clinicians to the increased ulcer risk associated with the neuropathy
- the screening and identification of a patient with loss of protective sensation is a major need to prevent diabetic foot ulcer formation and the increased risk of amputation

scientifically sound are often applied to foot ulcers (16).

Callus formation is due to increased local plantar pressure and this finding was observed in 21% of patients. There is a lack of health care professional training to remove callus and to redistribute increased plantar pressure. Callus formation is also an early sign of the loss of protective sensation due to clinically significant sensory neuropathy. In Iran, monofilament testing for loss of protective sensation has not been incorporated into routine clinical practice. Peripheral neuropathy is often diagnosed with loss of sensation by history asking about the symptoms of numbness, tingling, crawling, shooting, stabbing, or burning. These symptoms may appear some time after the very sensitive monofilament test would have been positive and alerted clinicians to the increased ulcer risk associated with the neuropathy. It is commonly believed that neuropathy appears 10–15 years after the appearance of diabetes. However, many Iranian PWD are younger than in other populations (52-years-old in our study) and it is likely that they will experience diabetic foot complications including bony deformities and foot ulcers with time. Our survey only measured point prevalence compared to reports that measure annual incidence accounting for a low percentage of some findings.

Assessment of the foot ulcer risk must always include a careful foot examination. Neuropathy with imbalance of flexors and extensors results in a claw foot deformity. The combination of proprioceptive loss due to neuropathy and high pressure combined with dry skin result the formation of callus under weight bearing areas (7–18). Neuropathy is most commonly associated with the development of foot ulcers in PWD (6). The presence of plantar callus has been shown in different studies as a highly significant marker of foot ulcer risk (6,18). Motor neuropathy affects the muscles required for normal foot movements, altering the distribution of forces during walking and causing thickening of skin or callus formation at sites of abnormal load (4). The screening and identification of a patient with loss of protective sensation is a major need to prevent diabetic foot ulcer formation and the increased risk of amputation (Figure 3) (6).

Pressure off loading is the most important component in treatment of diabetic foot ulcers (3). The studies with total contact cast (11,19) provide a gold standard of pressure downloading. Patient should be advised not walk in the same shoes that contributed to ulcer formation without appropriate orthotic and pressure off loading (19) (Figure 2).

In a study conducted at Tehran University, Shariati hospital there was a significant relationship between the presence of neuropathy detected by nerve conduction study and older age, male gender, poor diabetic control and longer duration of disease (20).

There were significant relationships between: callus formation and hammer toe

Figure 3. Diabetic foot ulcer (post surgical).

Table 3 The association between callus and other diabetic food complications

	With callus (%)	Without callus (%)	Odds Ratio	*P* value
Ulcer	9·8	2·6	4	0·03
Hammer toe	17·6	6·1	3	0·02
Absence of post tibialis pulse	29·4	7·7	5	0·00

(Table 3). Structural deformity is a significant risk factor for ulceration (6). In this study 10% of patients had history of previous ulcer and these patients are to a higher risk of developing another ulcer. Previous studies reputed that it has shown that 20–58% of patients develop another ulcer within a year after healing a wound (6).

It has been nearly seven decades since the discovery of insulin and despite advances in awareness and treatment of diabetes, diabetic foot ulcers remain a terrible complication of the disease (4). Increasing interest in the diabetic foot complications in recent years has resulted in a better mechanistic understanding of risk factors associated with foot ulceration and amputation (15).

NEXT STEPS

As a result of this survey we need to:

- Introduce a comprehensive patient self examination program along with prevention strategies for skin break down (fissures, calluses and ulcers).
- Implement improved vascular assessment protocols with hand held Dopplers and the ability to measure toe pressures in the clinic, linked to complete non invasive and invasive testing to identify and promptly treat by passable or dilatable lesions.
- Identify callus formation in its evolution early and promote their removal along with a program for pressure downloading and monitoring.
- Foster patient and health care professional co-operation for early treatment to avoid unnecessary amputations.
- Train interprofessional teams to develop expert knowledge for detection of high risk patients, coordinated patient care and improved patient outcomes.
- Establish evidence informed practices by modifying existing high quality guidelines for local needs in Iran and institute a plan for implementation.

Many Iranian patients with diabetic foot ulcers are living with disability because of economic, social, cultural and medical barriers. We need to pay more attention to the most common risk factors for foot ulceration: history of previous ulcer, peripheral neuropathy, callus formation, deformities including hammer toes and absence of dorsalis pedis pulses.

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Key Points

- the next steps are provided as a result of this study: 1) introduce a comprehensive patient self examination program along with prevention strategies for skin breakdown (fissures, calluses and ulcers) 2) implement improved vascular assessment protocols with hand held Dopplers and the ability to measure toe pressures in the clinic, linked to complete non invasive and invasive testing to identify and promptly treat by passable or dilatable lesions 3) identify callus formation in its evolution early and promote their removal along with a program for pressure downloading and monitoring 4) foster patient and health care professional cooperation for early treatment to avoid unnecessary amputations 5) train inter professional teams to develop expert knowledge for detection of high risk patients, coordinated patient care and improved patient outcomes 6) establish evidence informed practices by modifying existing high quality guidelines for local needs in Iran and institute a plan for implementation

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