جمهورية العراق

وزارة التعليم العالي والبحث العلمي

UNIVERSITY OF DIYALA

COLLEGE OF MEDICINE

DIABETIC FOOT DISEASE

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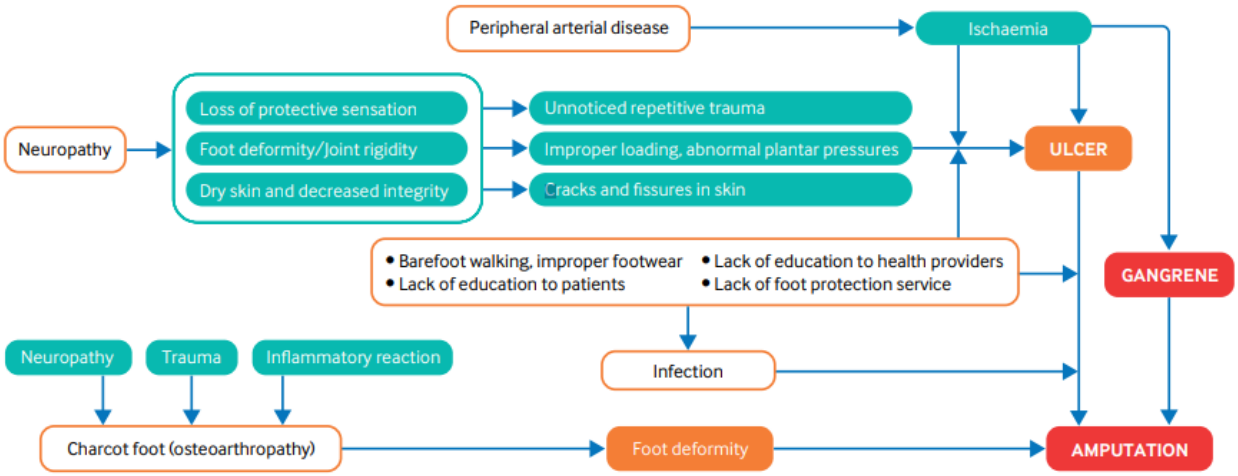
Abstract

Background: Diabetes is considering being wide world disease and with it carries the increased risk of complications. Disease of the foot is among one of the most serious and feared complications of diabetes. The term 'Diabetic Foot' consists of a mix of pathologies including diabetic neuropathy, peripheral vascular disease, Charcot's neuroarthropathy, foot ulceration, osteomyelitis and the potentially preventable endpoint, limb amputation. ***Objectives:*** The aim of this study was to assess the outcome of diabetic foot ulcers among Iraqi patients with diabetes and to examine the effect of some risk factors on healing of the ulcer. ***Methods:*** A cohort study was conducted on 100 candidates from different geomorphological areas. ***Results:*** A total of 100 patients with diabetic foot ulcers were included. The ulcers of 60% of the patients was discharged from the hospital with healed ulcer, whereas 8% persisted unhealed; 25% of the patients had a minor amputation, 5% had a major amputation, 1% had recurrent ulcers, and 1% died from serious complications. The study showed a significant association between diabetic foot ulcer healing and the following variables: patients' age, $HbA_{1c\ level}$, duration of diabetes, diabetic complications like peripheral neuropathy, and ulcer size. ***Conclusions:*** Diabetic foot ulcer outcomes can be predicted by several factors, some of which are modifiable with better control of diabetes, treatment of peripheral neuropathy, and early management of ulcers, may improve the outcome and end up with good prognosis.

Introduction

Diabetes is considering being wide world disease and with it carries the increased risk of complications. Disease of the foot is among one of the most serious and feared complications of diabetes. The term 'Diabetic Foot' consists of a mix of pathologies including diabetic neuropathy, peripheral vascular disease, Charcot's neuroarthropathy, foot ulceration, osteomyelitis and the potentially preventable endpoint, limb amputation(Between 0.03% and 1.5% of patients with diabetic foot require an amputation). (1)The lifetime risk of a person with diabetes developing foot ulceration is reported to be as high as 25%. It is estimated that

more than a million people with diabetes require limb amputation each year, suggesting that one major amputation is performed worldwide every 30 s. Amputation is associated with significant morbidity and mortality, besides having immense social, psychological and financial consequences. As the majority of limb amputations in patients with diabetes are preceded by foot ulceration, it is essential that strategies are directed (2) towards preventing this devastating complication. It has been shown that up to 50% of amputations and foot ulcers in diabetes can be prevented by effective identification and education of diabetic patients. (3-4) Uncontrolled diabetes is the cornerstone for the development of diabetic foot diseases which started with neuropathy and peripheral arterial disease by a complex of metabolic pathways.1) Loss of sensation caused by peripheral neuropathy, 2) ischemia due to peripheral arterial disease or a combination of these may lead to foot ulcers. A systematic review (78 studies from 84 cohorts) reports a prevalence of 0.003-2.8% for diabetes related peripheral neuropathy and 0.01-0.4% for diabetes related peripheral arterial disease. Diabetes is also implicated in Charcot arthropathy, which involves progressive destruction of the bones, joints, and soft tissues, most commonly in the ankle and foot.(5) Diabetes related Charcot's arthropathy has a reported prevalence between 0.08% and 13%, but there are no high quality epidemiological studies on Charcot's foot. A combination of neuropathy, abnormal loading of foot, repeated micro trauma, and metabolic abnormalities of bone leads to inflammation, causing osteolysis, fractures, dislocation, and deformities. Furthermore, Foot problems account for more hospital admissions than any long-term complications among patients with diabetes. An understanding of the causes of these problems enables the doctors for early recognition of patients at high risk. (6-8)



The process of diabetic Foot ulceration initiated as a result of trauma (the most common precipitant is accidental trauma, especially from ill-fitting footwear) Once the skin is broken, many processes contribute to defective healing, including bacterial infection, tissue ischaemia, continuing trauma, and poor management, and in the presence of sensory loss and/or peripheral vascular disease.(10) A Contrary belief stated that the infection is not the primary cause of foot ulcers, but is a secondary phenomenon following ulceration of the protective epidermis. Advanced somatic neuropathy results in insensitivity, facilitating trauma, and altered proprioception and small-muscle wasting in the presence of limited mobility in the sub-talar and mid-foot joints, which lead to altered loading under the foot on standing and walking. This combination of insensitivity and high pressures applied to the foot places the patient at great risk of neuropathic ulceration.(11) Such patients usually have peripheral autonomic dysfunction, which, in the absence of peripheral vascular disease, results in increased resting blood flow; it should be noted that warm, insensitive feet are very much at risk. This 'autosympathectomy' also leads to dry skin that cracks and fissures, and repetitive high pressure leads to formation of callus tissue beneath weight-bearing areas. A recent study has shown that the presence of callus in an insensitive foot is highly predictive of subsequent foot ulceration. Peripheral vascular disease is more common in patients with diabetes and is a major factor in the aetiology of ulceration. Pure ischemic ulcers probably represent only 10% of diabetic foot lesions; 90% are caused by neuropathy, alone or with ischemia.

(12) In recent years, the incidence of neuro-ischaemic problems has increased, and neuro-ischaemic ulcers are now the most common lesions seen in most of the world diabetic foot clinics: similarly, in Europe, peripheral vascular disease was present in 49% of foot ulcers with infection present in 58%. Assessing the diabetic foot represents a crucial element of the annual diabetic follow up. It is indeed essential to identify the foot at risk earlier which include(evidence of neuropathy ,evidence of ischemia, foot deformity(13) (e.g. claw toes, Charcot changes) ,callus at pressure areas ,previous history of foot ulcers ,impairment of eye sight (patients with restricted vision may injure their feet when attempting self-care, nephropathy is more common in patients with retinopathy, and those with end-stage renal disease on dialysis are amongst the highest risk patients for foot ulceration and amputation and poor social circumstances (e.g. the elderly, particularly those lives by their own)(14) , so as to target preventative and therapeutic measures at the earliest opportunity. Additionally, despite preventive measures, patients may still develop ulcers and a system of classification is therefore important. In recent years, many new ulcer classification systems have been proposed; one of the most commonly used is that devised at the University of Texas. In this system, grades refer to the depth of the wound, and each grade has four stages, depending on the presence or absence of infection and/or ischemia.

University of Texas (UT) diabetic wound classification system

Stage	Grade			
	0	1	2	3
A	Pre-ulcerative or post-ulcerative lesion, completely epithelialized	Superficial wound, not involving tendon, capsule or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
B	With infection	With infection	With infection	With infection
C	With ischaemia	With ischaemia	With ischaemia	With ischaemia
D	With infection and ischaemia	With infection and ischaemia	With infection and ischaemia	With infection and ischaemia

Subjects and Methods

This was a cohort study among Iraqi patents, from January to August 2017. All patients with diabetes aged 18–90 years and having DFUs were included. Those

who had diabetic foot lesions other than ulcers or those who had no diabetes were excluded from the study. A total of 100 adult patients with DFUs were included in this study. The demographic data and duration of diabetes were recorded. The diagnosis of peripheral neuropathy was based on clinical signs and symptoms, in addition to insensitivity of the foot to 10-g Semmes-Weinstein monofilament, loss of vibration perception tested by using a 128-Hz tuning fork on the medial malleolus and the dorsal aspect of the big toe, and the absence of ankle reflexes. The diagnosis of ischemia in the foot was based on bedside examination, by looking for specific presenting signs and symptoms (dry, shiny, hairless skin on the affected limb; brittle nails; and skin which is cool to touch) with measurement of the ankle-brachial index. A result of 1–1.2 was considered normal. A result <0.9 was considered abnormal. A laboratory blood test for HbA_{1c} was ordered. HbA_{1c} was measured by BIO-RAD D-10 high-performance liquid chromatography. In addition, a clinical examination of the ulcer and measurement of its size were done. Clinical evidence of an infection according to the Infectious Disease Society of America (IDSA) was noticed. After that, treatment was started with surgical debridement to remove all nonviable tissue. Follow-up was conducted weekly for 6 months and the outcomes were classified into one of the following six categories:

- Healing as a continuous viable epithelial covering over the entire or previously open wound.
- Persisting unhealed(as incomplete re-epithelialization of the wound)

- Minor amputation(defined as amputation restricted to the foot, not affecting walking ability (transmetatarsal, tarsometatarsal, or Lisfranc's amputation)
- Major amputation(defined as amputation performed above the level of the ankle)
- Recurrence as a re-ulceration which most commonly occurring on the same affected foot
- Death

Results

A total of 100 patients were included in this study. 51 were male and 49 female. The mean age of the participants was 53.6 ± 9.6 years. 61 of the participants were overweight or obese. The majority of them had type 2 diabetes mellitus. Two-thirds were on insulin injections, either combined with oral hypoglycemic drugs or not. 14% of the participants were smokers over a long period of time. The study

was classified the patients into three age groups: 25–45, 46–64, and ≥65 years.

Characteristic	Subjects, *n*
Gender	
Male	51
Female	49
BMI	
Normal	39
Overweight	33
Obese	28
Type of DM	
Type 1	4
Type 2	96
Treatment of DM	
Oral antidiabetic	35
Insulin	36
Combined	27
No treatment	2
HbA_{1c}	
<7%	14
>7%	86
Infection (clinical)	
Present	45
Absent	55
Smoking	
Current smoker	15
Ex-smoker	40
Nonsmoker	45

BMI, body mass index; DM, diabetes mellitus.

The percentage of healed ulcers according to each variable is summarized in. The different statistical significance was maintained after applying multiple logistic regressions.

Risk factor	Groups	Healed DFUs, %	*p* value
Age	25–45 years	100	0.006
	46–64 years	62	
	≤65 years	0	
DM duration	<5 years	100	0.0001
	5–10 years	100	
	>10 years	39	
HbA_{1c}	≥7%	100	0.007
	>7%	53	
Peripheral neuropathy	Present	51	0.03
	Absent	100	
Ulcer size	<1 cm	100	0.001
	1–5 cm	48	
	>5 cm	0	

DFUs, diabetic foot ulcers; DM, diabetes mellitus.

The association between duration of DM and DFU outcome, 39% of those with a duration of their DM of >10 years had healed, compared to 100% of those with a duration <10 years.in the other hand, the relation between HbA_{1c} level and DFU results, those with HbA_{1c} <7% had a 100% healing rate, compared to those with HbA_{1c} >7%, of whom only 53.6% had healed ulcers.

Finally, studying the association between ulcer size and DFU outcome revealed that 73% of those patients with an ulcer size >5 cm ended up with a minor amputation. In contrast, those with small ulcers (<1 cm in diameter) had a 100% healing rate (p = 0.001).

Discussion and Conclusion

The above mentioned study was conducted on 100 patients with DFUs who had attended the Diabetic Foot Clinic. There was no gender difference, and the majority of the participants were in the middle age group. Most of the patients had type 2 DM, which is more common than type 1 DM. In addition, around two-thirds were on insulin injections, which may reflect to the long duration of diabetes among those affected people. The study shows that patients who aged more than 65 years have a poor prognosis compared with other age groups; another study was conducted with the same purpose, **Data** collected prospectively from the local patients in the city of Nottingham in the UK and it was in a consecutive cohort of patients referred to a specialist multidisciplinary foot care clinic between 1 January 2000 and 31 December 2003 were analyzed. Ulcer-related outcomes (healing, resolution by ipsilateral amputation or by death, and persisting unhealed) were determined at 6 and 12 months and compared with patient-related outcomes (survival, any amputation, and being free from any ulcer) at 12 months. A total of 183 (40.8% of 449) ulcers were clinically infected, and peripheral arterial disease was present in 216 patients (48.1%). Of the ulcers, 247 (55.0% of 449) and 295 (65.7%) healed without amputation by 6 and 12 months, respectively. Median (range) time to healing was 78 (7-364) days. Of all ulcers ratio, 5.8 and 8.0% were resolved by amputation, and 6.2 and 10.9% by death by the same time points; 27.8 and 11.6% persisted unhealed. In contrast, patient-related outcomes revealed that of 449 patients only 202 (45.0%) were alive, without amputation, and ulcer free at 12 months. This group had had 272 (1-358) days without any ulcer. A total of 48 (10.7%) patients had undergone some form of amputation, and 75 (16.7%) had died. For that reason, it is suggested that when attempts are made to compare the effectiveness of management in different centers, greater emphasis should be placed on patient-related outcome measures, and it is believed that the foot cares for the great majority of significant lesions in those who live in the local areas where hospitals and diabetic clinic are not far from the patients.(15) The results emphasize the poor prognosis of lesions managed in such a service, with only 59.2% of all ulcers healing at some stage without amputation within 12 months and another 8.0% being resolved by amputation (major or minor). (16) The DFUs in all those with a

duration of DM <10 years had healed. This is similar to the findings of two other studies, one from Saudi Arabia and one from China. Both microvascular and macrovascular complications of DM are directly related to the duration of the disease.

From the above mentioned observations, it confirms that those people with poorly controlled DM, as reflected in an HbA_{1c} >7%, had a poor outcome with regard to DFUs. Consequently, optimal adherence to the treatment and daily follow up of plasma glucose level will halt the progression of all complications including DFUs.(17-19)

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