Diabetic Foot Causes and Outcomes
A Study in Wassit Province, Iraq

"If you are diabetic; remember: Your feet should be as clean as your face"

"When you die, you will die because of your feet"

(Old English Saying)

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قدم السكري,الاسباب والنتائج (دراسة في محافظة واسط - العراق)

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Abstract

Diabetic foot (DF) as a complication of Diabetes Mellitus (DM) was studied in 88 Iraqi adult patients in Wasit Province at their visit to Al-Karama Teaching Hospital during the period from April 2010 to March 2012.Eighty eight patients were enrolled, 58 males with mean age of 63±8.4 SD years, and 30 females with mean age of 65±4.1 SD years. The mean duration of Diabetes Mellitus was 10.5 years. Uncontrolled hyperglycemia was documented nearly in all patients at presentation.More than 90% of the patients were non-compliant with diet , drugs or both and 88% of them have high body mass index (BMI >26 Kg/m^2) . Other co-morbidities also co-exist, 72.7% of them have peripheral neuropathy (mainly sensory), 54.5% have hypertension,40.9% of them are active smokers, 39.7% ischemic heart disease, 35% peripheral arterial disease , 34% history of trauma, 29.5% have hyperlipidemia(Table 1). Many of them have more than one risk factor concomitantly. The presenting Diabetic Foot problems were: ulcers in 45 patients, gangrene of the toes and/or the feet in 24 patients, abscess or cellulitis in15 patients and 4 patients presented with miscellaneous conditions (Table 2). Conservative treatment was successful in 95.3% of non-gangrene diabetic foot conditions .But 24 patients who presented with gangrene were in need of some sort of amputation of toes or more proximal ,especially those older than 65 years of age with multiple risk factors. Foot negligence, mis-care, mal-footwear and lack of knowledge about the sequels of diabetic foot by the patient were the main precipitating factors that augment the problem and worsen the outcome. The education programs about Diabetic Foot and correction of risk factors can do a lot to minimize the problem

المستخلص

تمت دراسة قدم السكري كأحد مضاعفات مرض السكري في 88 مريضا عراقيا من البالغين في محافظة واسط لدى زيارتهم مستشفى الكرامة التعليمي في مدينة الكوت للمدة من شهر نيسان 2010 الى شهر اذار2012 . شملت الدراسة 58 من الذكور بمتوسط عمر63±8.2 سنة وثلاثون من الاناث بمتوسط عمر65±4.1 سنة, كان متوسط مدة مرض السكري 10.5 سنة.

عند زيارتهم المستشفى لأول مرة وجد أن أغلبهم لديهم ارتفاع وعدم سيطرة على مستوى السكري في الدم وأن أكثر من 90% منهم لم يكونوا ملتزمين بالحمية الغذائية او أخذ دواء السكري أو الأثنين معا. ولدى88% منهم زيادة في الوزن أكثر من 26كغم/م2 مع وجود أمراض اخرى مصاحبة للسكري مثل التهاب الاعصاب المحيطية خاصة الحسية منها ،ارتفاع ضغط الدم ،التدخين، قصور الشرايين التاجية وقصور الشرايين بالأطراف زيادة نسبة الدهون في الدم، وفي حالات كثيرة كانت القدم قد تعرضت الى شدة خارجية ايضا .و كان هناك اكثر من سبب في نفس الوقت عند بعض من المرضى (جدول رقم 1).

أن نوع الاصابة في حالات قدم السكري التي وجدت في هذه الدراسة كانت كالاتي: قرحة القدم في 45 مريضا ، كانكرين اصابع القدم او القدم لدى 24 مريضا, خرّاج القدم أو التهاب الأنسجة الرخوة في القدم في 15 مريضا وأصابات متنوعة اخرى في4 مرضى اخرين .

العلاج التحفظي نجح بنسبة 95.3% من المرضى في الحالات غير المصابة بالكانكرين و لكن 24 مريضا ممن لديهم اصابة بالكانكرين احتاجوا الى نوع من البتر في اصابع القدم او أكثر، خاصة ممن عمرهم أكثر من 65 سنة وكان لديهم أكثر من مسبب لقدم السكري.

أظهرت الدراسة أن من اهم مسببات قدم السكري هو سوء العناية في القدم او عدم مراعات الحذاء المناسب للقدم وعدم معرفة عقابيل قدم السكري من قبل مرضى السكري مما يجعل النهاية سيئة . ان البرامج التثقيفية حول العناية في القدم ومعالجة مسببات قدم السكري والعلاج المبكرالصحيح لاصابة القدم يمكن ان تفعل الكثير لتذليل المشكلة.

Introduction

Diabetes Mellitus (DM) is a major health and financial problem causing a lot of waste of work and money [1, 2, and 3]. Approximately 8.6 percent of the adult population is diabetic; the condition is slightly more prevalent among women than men. It is defined as the clinical syndrome that is characterized by hyper-glycaemia due to lack of endogenous pancreatic insulin amount, action or both or abnormal hepatic glucose production, with subsequent metabolic defects in the metabolism of carbohydrates, proteins lipids, electrolytes and water in the body .Despite all medical education programs, (DM) is still growing among all classes of society leading to more disabilities and deaths. Although its main metabolic problem is glucose metabolism, but other metabolic defects accompany, and follow that, especially over-eating and overweight [4, 5] .The problem becomes more complex, because many diabetic patients either have mild symptoms or they underestimate its long term sequels, so that many of them present with its complications at the time of diagnosis of DM for the first time.

Diabetes Mellitus is classified into two major types: Type 1 DM that occurs in acute pattern in non-obese young patients, and needs insulin therapy from the time of diagnosis and Type 2 DM (which represents more than 80% of all DM), it usually occurs in adult obese patients with genetic predisposition and has insulin resistance, commonly accompanied with other high risk factors of ischemic heart disease.

The duration of DM and the degree of hyperglycemia have the major burden on body tissues and organs. Vascular bed receives the most harmful effect of hyperglycemia. So with time, hyperglycemia and the effects of other risk factors on the vessels, lead to further damage

that occurs prematurely and more aggressively as compared to those non-diabetic peers with similar risk factors. Peripheral neuropathy makes more medical problems that augment vascular defects [6, 7].

Diabetic foot (DF) may present as simple skin infection to foot gangrene that necessitates amputation. Based on the World Health Organization [WHO] definition: the Foot of DM patient has the potential risk of pathological sequences, including infection, ulceration, and/or destruction of deep tissues associated with neurological abnormalities, various degrees of peripheral vascular disease and/or metabolic complications of diabetes in the lower limb[8 ,9]

Diabetic foot is one of the major crippling complication of DM. It affects more than 250 million diabetic patients in the world [estimated amputation is 1 of 5 patients with diabetic foot which may need re-amputation. Nearly one million amputations each year, the majority of them were preceded by ulcers; with median time for complete ulcer healing is few months [10, 11, and 12]

Diabetic Foot (DF) problems, as presentations, triggering factors, accompanied risk factors, degree of glycaemic control, hospital management as in-patients, outpatients and the outcome of the problem was studied in Al Karama Teaching Hospital, Wasit Province, Iraq.

Patients and materials

Eighty eight (*n*=88) Iraqi diabetic patients from Al-Kut city and its peripheries of Wasit Province, Iraq, with diabetic foot problems who consulted Al- Karama Teaching Hospital ,Wassit Province in the period from April 2010 to March 2012 were enrolled in this study, 58 males with mean age 63±8.4 SD years and 30 females with mean age 65± 4.1 SD years

Records of the presenting foot problem at their visit include :[duration of DM, anti-diabetic treatment regimen ,duration of(DF) , any previous history of leg ulcer or trauma, Peripheral Neuropathy (PN) is considered if the patients have foot numbness , absence of pain sensation or impaired vibration sense (tested by tuning fork 128 dcb), history of peripheral arterial disease(PAD) (claudication)], presence or absence of any coexisting risk factors such as ischemic heart disease (IHD), hypertension(HT), Hyperlipidemia (hypercholesterolemia), smoking ,and if there are long term complications of DM such as Nephropathy (albuminuria) Retinopathy. Body mass index is recorded (BMI).

Records of examination of both feet (ulcers site, size, depth, margins ,base and the presence of infection),the nails, if any callus or deformities in the toes , the shape of shoes of the patients, checking pedal pulses, dorsalis pedis artery on the dorsum of the foot and posterior tibial artery behind the medial malleolus and capillary filling time for PAD , peripheral sensation and position sense ,vital signs (blood pressure, pulse rate , temperature), cardiac examination, Doppler study of leg arteries in selected cases, when dorsalis pedis and posterior tibial arterial pulses could not be felt, x-ray of the infected foot to exclude bone infection , fasting venous blood glucose (FBS) , random venous blood glucose (RBS) ,

glycated hemoglobin (HbA_1C) ,serum lipids profile ,packed cell volume (PCV), white cell count (WBC), erythrocytes sedimentation rate (ESR), general urinalysis (GUE) , blood urea(BU) and serum creatinine (S .C) . Records fixed at their visit, and during in-patients follow-up.

Treatment options were addressed according to the DF problem and limb vascularity. Those with superficial skin ulcers were treated conservatively by local care (debridement, dressing and antibiotics), while abscess was incised and drained. Gangrenes were treated by amputations at different levels (Table 4). Follow-up records during their inpatient include: daily local care, control of hyperglycemia by insulin and/or oral hypoglycemic drugs, blood pressure monitoring and metabolic derangement, antibiotics, and the final outcome of the diabetic foot. Cooperation was needed between physicians, general surgeons and orthopedic surgeons in all cases about the suitable measures for each patient individually.

Results

All patients were already diagnosed to have DM before their visit. About 94% of them were with uncontrolled hyperglycemia (Table 3) , their mean fasting glucose > 180 mg/dl , mean random blood glucose > 210 mg/dl and mean glycated hemoglobin A1 (HbA_1C) 9.6 , at their visit to the hospital (optimum fasting venous blood glucose ≤ 126 mg% , 2 hours post prandial venous blood glucose <180 mg% and optimum diabetic control in the past 2-3 months value of HbA_1C is ≤ 7) . Seventy five percent of patients have DM for more than 12 years, mean duration (10.5 years), 44 patients (50%) were using oral hypoglycemic drugs only for their diabetes, while 34 patients (38.6%) used insulin with oral anti-diabetics and 10 patients (11.3%) used only insulin. They consulted the hospital mostly after they have foot skin changes, ulcers, cellulitis, blisters or beginning of foot black discoloration (gangrene) (Table 2). Peripheral neuropathy (especially sensory) in both feet was found in 64 patients (72.7%) with DF, HT in 48 patients(54.5%) , active smoking in 36 patients(40.9%) , IHD in 35 patients (39.7%) ,PAD in 31 patients(35%) at presentation (pain in the feet, with changes in skin color texture and absent pulse) ,history of trauma to the foot in 30 patients(34%) and presence of hyperlipidemia in 26 patients (29%) (Table 1).

The duration of DF problem was very short when gangrene started, but very long in those with little pain or minor ulcers (Table 3).

Gangrene was seen more in the elderly males with mean age of more than 65 years, but there were no ischemic insults in those below 28 years of age (Table 2). Fifty percent of ulcers were in the planter surface of the feet and 36% on the toes while 14% on the dorsum and lateral sides and bilateral feet ulcers in 12 % of patients: figures (1, 2, 3, and 4)

Table 1: Prevalence of risk factors in patients with DF according to gender and age (M =male, F= female)

Risk factors	Number of patients	%	Gender & number	Mean age in years
Peripheral neuropathy	64	72.7	M=43	6 9.1
			F=21	67.6
Hypertension	48	54.5	M=29	64.7
			F=19	57.7
Active smoking	36	40.9	M=27	54.7
			F=9	59.3
IHD	35	39.7	M=20	58
			F=15	59.1
Peripheral arterial disease (PAD)	31	35.2	M=17	68.8
			F=14	66.8
Trauma	30	34	M=20	69
			F=10	66.8
Hyperlipidemia	26	29.5	M=15	55.5
			F=13	60

Table 2: The frequency of DF types at presentation in relation to gender and age (M=male F=female, n= number of patients)

Diabetic Foot	Number of patients(*n*)	Number of patients according gender and age			
		Gender	Age<40 years	Age 40-65 years	>65 years
ulcers	45	(*n* =30) M	6	10	14
		(*n* =15) F	-	9	6
gangrene	24	(*n* =14) M	-	5	9
		(*n*= 10) F	-	3	7
abscess	15	(*n* =10) M	6	3	1
		(*n*= 5) F	2	3	-
Others (callus, xerosis ,nail deformities)	4	(*n* =4) M	-	3	1
		(*n* =0) F			
Total	88	88	14 (15%)	36 (42%)	38 (43%)

Table (3): DF types and their duration before hospital visit, with glycemic control at presentation

diabetic foot problems at presentation	number of patients	Mean duration of DF problem (days)	glycaemic control
superficial skin ulcer and bullae	45	10	poor control
gangrene	24	2	poor control
cellulitis and abscess	15	7	poor control
Others (callus ,xerosis and nail deformities)	4	70	Poor control

Figure 1 :Gangrene and ulcer

Figure 2 : Bilateral gangrene in the toes

Figure 3: DF ulcer

Figure 4 :DF blister

Many of them have more than one risk factor (Table 1). Vast majority of patients were not compliant with diet regimen, anti-diabetic drugs or both, body weight was more than the ideal in 88% (the mean body mass index (BMI) > 26 kg/m^2.

During inpatient treatment and follow up 95.3% of non–gangrene cases were successfully managed by conservative treatment (insulin, oral anti-diabetic drugs, analgesia, antibiotics, simple debridement and dressing), while 6 patients needed re-admission after discharge. Twenty four patients (27%) needed amputation of toes, foot or below the knee to ensure lifesaving, especially older ones who presented with established gangrene and multiple co-existing risk factors such as HT, PAD, Hyperlipidemia, IHD, and long duration of DM (Table 4).

Table (4): DF types and their management during inpatients care

Diabetic Foot problem	Male (*n*)	Female (*n*)	Total and (%)	Treatment
Ulcers	30	15	45 (51%))	Insulin + antibiotic +debridement
Abscess	10	5	15 (17%)	Drainage +insulin +antibiotic+ dressing
Gangrene of toes	13	8	21 (23%)	Toes or mid-tarsal amputation
Foot gangrene	2	1	3 (3.4%)	below knee amputation
Others	3	1	4 (4,6%)	Insulin + antibiotic
Total	58	33	88 (100%)	88

Discussion

Diabetic foot is a major medical and surgical problem which leads to higher morbidity and mortality with a lot of distress to the patients and their families and may lead to permanent disability [13]. It is responsible for about 20% of all hospital admissions of patients with diabetes. Many of them may need lower extremity amputation at some time in their lives [14, 15, and 16]. About 80-85% of amputations were preceded by non-healing foot ulcers [17, 18, 19, and 20]. In many studies the main predisposing factors for DF were :old age, male gender, duration of DM and poor glycemic control ,smoking , IHD, Hyperlipidemia, hypertension, trauma, PNP, PAD [6,17,18,20]. Other studies [21, 22, 23, 24, and 25] considered the leading risk factors for DF was one or more of the following:

1-Peripheral neuropathy

2-Peripheral vascular insufficiency of the lower limbs

3-Connective tissue abnormality.

Some studies reported the peripheral neuropathy of about 70- 80% of diabetic patients with foot ulcer [12, 17]. In our study, it was 72.7%. Some researchers reported peripheral arterial disease (PAD) four times more common in individuals with diabetes as compared to those without diabetes [8,10].It was 32.2% of the diabetic patient in this study .Trauma and foot self-mal-care were reported in 34% of cases in some studies [19, 21 ,22],it was 28.3% in this study .

Other risk factors reported in higher rates in our study are :HT in54.5%, active smoking in 40.9 % , IHD in 39.7% and hyperlipidemia in 29.5%.These factors were also present in many studies with variable significant rates[10, 12,17, 18] . The lack of patient's awareness and/ or neglection of

simple foot lesions or insufficiency of medical services afforded to the patients make additional factors for the disastrous outcome [26, 27, 28, and 29]

Male gender preponderance is recorded in studies at (Baghdad, Hila, Basrah) [23, 28, and 30]. Our study showed similar rates Male: Female 2:1. This may be explained by other risk factors such as smoking habit which is more in the males (Table 1). Male diabetic patients are also more prone to have diabetic foot infection than female [31]. Diabetics who develop foot infections are usually above fifty years old. Wounds in diabetic patients become infected five times more often than non-diabetic patients and the rate of infection parallels the blood glucose levels [31, 32]

In this study, the frequencies of DF according to age: were 15% in patients below 40 years, 42% in patients between 40-65 years and 43% in patients above 65 years (Table 3).These rates were found also in other studies [29].Gangrene lesions were not seen below 40 years in this study (Table 2)

In general, the predisposing risk factors to DF in this study were complex, at least there were two risk factors in all patients, and in 47% of them, there were three or more risk factors concomitantly (Table 1), especially elderly patients. In other studies, the predisposing factors were similar but the outcome somewhat different, which may reflect the difference in health service programs or the prevalence of more specialized diabetic clinic [14, 22].

Slight increase in the incidences of DF was recorded among those who live in rural areas, probably because of lack of medical service access after infection of skin abrasion and lack of knowledge about care and prevention. Control of DM and care of DF is the first and the most important step in limitation of complications like amputation in diabetic patients, a study in Al-Hilla Teaching Hospital-Babil found a significant association between HbA1c level and poor prognostic outcome (amputation or death) in patients presented with diabetic foot. Levels of HbA1c more than 8 indicate poor diabetic control during last three to four months prior to presentation and were associated with bad outcome[33, 34**]** .This is compatible with our study in that the duration of uncontrolled hyperglycemia carried bad outcome .

Diabetic Foot presentations in a study carried in Al Basrah revealed the following rates: foot ulcer 63%, abscess 11.7%, toes gangrene 12.3%, and foot gangrene2.7% [13].In our studies, 51% of the patients were presented with ulcers. Foot abscess was 17% of cases and was treated by drainage and antibiotics. Gangrene of the toes was 23% while foot gangrene was 3%. Both were treated by amputation (table 3)

Conclusion

Diabetic Foot problem is a complex and underestimated by the patients and sometimes by their healthcare givers leading to delay in the management. These result were in high rate of amputation and permanent disability. Conservative treatment and minimal surgical intervention were successful in dealing with 73% of patients, these points, that the better orientation and care can minimize

amputation and disability. Although the sample of this study was small and in one center, it clearly indicates the need for multi-centric large samples to get the real size of this problem

Recommendations

There is an increasing need for preventive measures to avoid limb amputation. Because there is a lack of knowledge of diabetic patients about the danger of crippling complication of their disease, there is a real need for education and orientation about the problem starting from the time of diagnosis of DM using all methods to get their attention about the harmful effects of neglecting their feet emphasizing on regular foot examination. All efforts should be tried to modify the risk factors early, giving better care of the feet especially in regard to the shape and size of their shoes with nail care in particular. Diabetic clinic with well-trained staff can do a lot in this aspect. Meanwhile , there must be a collaboration work between physician, orthopedic surgeons, nursing staff and podiatrist to minimize undue surgical intervention and disability.

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