

CLINICAL RESEARCH ARTICLE

Risk factors for occurrence and recurrence of diabetic foot ulcers among Iraqi diabetic patients

Samer I. Mohammed, MS, Ehab M. Mikhael, MS*, Fadia T. Ahmed, MS, Haydar F. Al-Tukmagi, PhD and Ali L. Jasim, MS

Clinical Pharmacy Department, College of Pharmacy, University of Baghdad, Baghdad, Iraq

There are a few studies that discuss the medical causes for diabetic foot (DF) ulcerations in Iraq, one of them in Wasit province. The aim of our study was to analyze the medical, therapeutic, and patient risk factors for developing DF ulcerations among diabetic patients in Baghdad, Iraq.

Keywords: *diabetes mellitus; risk factors; diabetic foot ulcerations*

*Correspondence to: Ehab M. Mikhael, Clinical Pharmacy Department, College of Pharmacy, University of Baghdad, Baghdad, Iraq, Email: ehab_pharma84@yahoo.com

Received: 1 September 2015; Revised: 15 January 2016; Accepted: 19 January 2016; Published: 15 March 2016

Diabetes mellitus (DM) is a chronic metabolic disorder that is highly prevalent around the world (1). DM is a challenging disease with many complications that is usually difficult to manage successfully. Many patients do not achieve good glycemic control and continue to suffer health problems as a result (1–3). Diabetic foot (DF) ulceration is one of the most common complications among diabetic patients (4). It has been shown that such a complication is highly prevalent among Iraqi diabetic patients (5, 6). DF ulceration is associated with significant morbidity and mortality (7, 8). Although many studies worldwide explained the risk factors for developing DF ulcerations (9, 10), but there are a few studies that discuss the medical causes for DF ulceration in Iraq, one of these studies was done in Wasit province (11). The aim of our study was to analyze the medical, therapeutic, and patient risk factors for developing DF ulcerations among diabetic patients in Baghdad, Iraq.

Patients and methods

A cross-sectional study in questionnaire format (Appendix) was prepared by the authors of this study and given to a convenient sample of adult diabetic patients who were receiving medical treatment. This study was done in a surgical ward in a Baghdad teaching hospital during January 2015–April 2015. An additional 10 diabetic patients who are related to the authors of this study were invited to participate in this study to increase the sample size. Seventy-nine patients who provided their verbal informed consent were included in this study.

Ethical approval for this study was obtained from the Ethical Committee of Pharmacy College–Baghdad University. In this study, the term DF referred to present and/or history of DF ulcer.

Statistical analysis

Statistical software (SPSS v. 12, Chicago, IL) was used for data input and analysis. Continuous variables were presented as mean \pm standard deviation (SD), and discrete variables were presented as numbers and frequencies. Chi-square test for independence was used to test the significance of association between discrete variables.

Unpaired *t* test was used to test the significance of difference in the mean of two independent samples. Pearson's correlation was used to test the correlation between continuous variables. For doing correlations, each categorical answer was rated using suitable ascending numbers starting from zero.

All *P* values used were asymptotic and two sided. Findings with a *P* value less than 0.05 were considered significant.

Results

The results shown in Table 1 indicate that diabetic patients who suffered from DF were significantly older than those without DF. A long history of DM (more than 10 years) was associated with the development of DF, while the presence of comorbid diseases was not associated with the development of DF.

Table 1. Demographic data of the patients

Parameter	Patients with diabetic foot	Patients without diabetic foot	<i>P</i>
Number of patients	54	25	0.001
Age	54.87 ± 11.05	48.92 ± 11.18	0.029
Gender			
Male (%)	28 (52%)	16 (64%)	0.312
Female (%)	26 (48%)	9 (36%)	
Duration of diabetes mellitus			
Less than 5 years (%)	12 (22%)	13 (52%)	
5–10 years (%)	13 (24%)	3 (12%)	0.009
More than 10 years (%)	29 (54%)	9 (36%)	
Ratio of patients with other comorbid conditions (hypertension, cardiac disease, renal problems, eye problems) (%)	16/54 (29.6%)	18/25 (72%)	0.000
Educational level			
Limited educational level (non-educated or primary school) (%)	29 (54%)	19 (76%)	0.132
Low educational level (secondary and tertiary school) (%)	13 (24%)	2 (8%)	
High educational level (college) (%)	12 (22%)	4 (16%)	

Table 2 shows that the most important factors that made diabetic patients more prone to develop DF were using a combination of insulin and oral antidiabetic agents, physical activity, and unavailability of medications in the public sector.

Table 3 shows that the frequency of DF occurrence is well correlated with the absence of a home glucose meter, less frequent blood glucose measurements, and with long duration of DM.

Table 4 shows that the high cost of home glucose meter strips was the main cause for unavailability of this apparatus.

Discussion

This study showed that the age of diabetic patients who suffer from DF were significantly higher than those without DF. Similarly, it was found that most of the patients who developed DF were in their fifth and sixth decades of life, with mean age of 59.3 years (12); furthermore, a long history of DM (more than 10 years) was associated with development of DF. In contrast to the finding in this study, researchers found that the duration of DM is not related to DF risk for patients in the United States (10), while another studies showed that diabetic patients who develop DF are usually those with long history of DM (12, 13).

Another important finding in this study is that the patient's educational level was not significantly different between diabetic patients with DF and those without DF; in contrast to the finding of this study, low educational level was a risk factor to develop DF in diabetic patients in the UAE (14). This difference may be because low level of education is very common among Iraqi diabetic patients (15).

In this study, the presence of comorbid diseases was not associated with the development of DF; while in many other studies comorbidities are associated with increasing DF incidence (17–19). One possible explanation for this strange finding is that whenever the demand for glycemic control increased (as in patients with medical comorbidities), the patient compliance with medical advice will be increased (19). This in turn could mean better glycemic control and fewer complications from hyperglycemic attacks (20, 21).

This study has shown there are many risk factors that make the diabetic patients more prone to develop DF, at which patients who are using a combination of insulin and oral antidiabetic agents were at high risk to develop DF. The same finding was observed in an Indian study where diabetic patients who use a combination of insulin plus oral hypoglycemic agents are at higher risk of developing DF ulcers (22). The use of combined therapy in diabetic patients is common and may be because DM is one of the diseases that progress and become less responsive to treatment with time (23). This hypothesis is consistent with the findings in this study because patients with a long history of DM were at high risk from recurrent DF ulcers. Moreover, it is well known that the use of many medications decrease patient compliance to therapy (24), which further mean losing glycemic control (20) and increasing DF ulcer risk to the patient (21).

Additionally, another finding in this study was the association between physical activity and the risk of developing DF, despite the fact that physical activity can improve glycemic control (25). This might be explained by the fact that most diabetic patients in this study had low educational levels, and around 50% of them did not inspect their feet regularly. This could result in a higher

Table 2. Factors that affect diabetic patients to develop diabetic foot

Parameter		DM patients with DF N = 54	DM patients without DF N = 25	P
Medication used	Oral antidiabetics (%)	24 (44%)	20 (80%)	0.009
	Insulin (%)	11 (20%)	3 (12%)	
	Both (%)	19 (36%)	2 (8%)	
Presence of home glucose meter	Yes available (%)	33 (61%)	16 (64%)	0.804
	Not available (%)	21 (39%)	9 (36%)	
Measuring blood glucose level	Daily (%)	11 (20%)	5 (20%)	0.930
	Weekly (%)	13 (24%)	7 (28%)	
	Rarely (%)	30 (56%)	13 (52%)	
Regular physician visit	Yes (%)	10 (19%)	8 (32%)	0.184
	No (%)	44 (81%)	17 (68%)	
Therapy compliance and adherence	Yes (%)	32 (59%)	10 (40%)	0.110
	No (%)	22 (41%)	15 (60%)	
Source of used medications	Public diabetic centers (free of charge) (%)	23 (43%)	7 (28%)	0.213
	Private community pharmacies (with fee) (%)	31 (57%)	18 (72%)	
Knowledge about disease and its complication	Yes (%)	22 (41%)	7 (28%)	0.274
	No (%)	32 (59%)	18 (72%)	
Knowledge about hyperglycemia symptoms	Yes (%)	11 (20%)	7 (28%)	0.452
	No (%)	43 (80%)	18 (72%)	
Anyone helps you in your treatment	Yes (%)	24 (44%)	10 (40%)	0.710
	No (%)	30 (56%)	15 (60%)	
Availability of prescribed medication in public centers	Yes (%)	3 (13%)	5 (20%)	0.002
	No (%)	20 (87%)	2 (8%)	
Patients who stop treatment if medications are not available freely	Yes (%)	6 (30%)	2 (33%)	0.876
	No (%)	14 (70%)	4 (67%)	
Regular foot inspection	Yes (%)	27 (50%)	8 (32%)	0.134
	No (%)	27 (50%)	17 (68%)	
Physical activity	Yes (%)	41 (76%)	11 (44%)	0.005
	No (%)	13 (24%)	14 (56%)	

DM: diabetes mellitus; DF: diabetic foot.

chance of foot wounds and blisters through physical activity. This in turn might be translated into higher risk for developing DF ulcers. This study also showed that unavailability of medications in the public sector, the free sector, is one of the major risk factors to develop DF ulcerations since nearly one third of participating patients stated that they will stop using their treatment if it is not freely supplied to them, this finding may be rational since many people in Iraq are below poverty line (26) and thus they are unable to purchase their medications from private pharmacies.

It is well known that DF has a high recurrence rate (27). In this study it was found that the frequency of DF occurrence was well correlated with less-frequent blood glucose measurements and with the absence of home

glucose meters. Most patients in this study stated that they didn't own a home glucose meter because even if they can purchase the apparatus they aren't able to afford the costly strips for the regular glucose monitoring. In this regard, the lack of home glucose meters is surely linked with less-frequent glucose monitoring, which was further linked to bad glycemic control (28), and eventually to more complications with DF. This finding is closely related to what is found by Mehmood et al., at which better glycemic control is associated with better outcomes for patients with DF and may decrease the rate of DF recurrence (29).

There are some limitations in this study like the small sample size and the cross-sectional rather than longitudinal design that affect the reliability of study conclusions

Table 3. Correlation between different parameters on diabetic foot frequency

Parameter	<i>R</i>	<i>P</i>
Medication used	0.236	0.086
Presence of glucose meter in patient's home	-0.274	0.045
Frequency of measuring blood glucose level	0.331	0.014
Medication adherence	0.169	0.223
Knowledge about hyperglycemia symptoms	-0.143	0.302
Knowledge about disease complication	0.149	0.281
Help with the treatment	0.221	0.108
Regular foot inspection	0.189	0.172
Physical activity	-0.172	0.215
Duration of disease	0.438	0.001
Gender	-0.058	0.945
Age	-0.070	0.901
Presence of comorbid conditions	0.229	0.101

Table 4. Reason for non-availability of home glucose meters for patients with diabetic foot

Parameter	<i>P</i>
Absence of home glucose meter	6 0.049
High cost of the apparatus	15
High cost of apparatus strips	15

and therefore, a longitudinal large-scale study should be performed to confirm the results of this study. It is recommended that the Iraqi Ministry of Health ensure adequate and continuous supply not only of antidiabetic medications but also of glucose meter strips; furthermore diabetic educational programs should be made freely available to all diabetic patients to ensure a better glycemic control which eventually decrease the risk of diabetic complications.

In conclusion, older patients, long history of DM, using multiple antidiabetic medications, and physical activity with less frequent inspection of the feet were some of the major risk factors for developing DF among Iraqi diabetic patients, while the frequency of glucose monitoring is inversely related to the recurrence of DF ulcers.

Acknowledgements

To Professor George Kent for his kind grammatical revision.

Conflict of interest and funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

References

- Kaul K, Tarr JM, Ahmad SI, Kohner EM, Chibber R. Introduction to diabetes mellitus. *Adv Exp Med Biol* 2012; 771: 1–11.
- Delamater AM. Improving patient adherence. *Clin Diabetes* 2006; 24: 71–77.
- Forbes JM, Cooper ME. Mechanisms of diabetic complications. *Physiol Rev* 2013; 93: 137–88.
- Tapp RJ, Shaw JE, de Courten MP, Dunstan DW, Welborn TA, Zimmet PZ. Foot complications in type 2 diabetes: an Australian population-based study. *Diabetes Med* 2003; 20: 105–13.
- Mansour AA, Imran HJ. Foot abnormalities in diabetics: prevalence and predictors in Basrah. *Pak J Med Sci* 2006; 22: 229–3.
- Mansour AA, Dahyak SG. Are foot abnormalities more common in adults with diabetes? A cross-sectional study in Basrah, Iraq. *Perm J* 2008; 12: 25–30.
- Apelqvist J, Bakker K, van Houtum WH, Schaper NC. Practical guidelines on the management and prevention of the diabetic foot: based upon the International Consensus on the Diabetic Foot Prepared by the International Working Group on the Diabetic Foot (2007). *Diabetes Metab Res Rev* 2008; 24: S181–7.
- Reiber GE, Vileikyte L, Boyko EJ, del Aguila M, Smith DG, Lavery LA, et al. Causal pathways for incident lower-extremity ulcers in patients with diabetes from two settings. *Diabetes Care* 1999; 22: 157–62.
- Abu Obaid HA, Eljedi A. Risk factors for the development of diabetic foot ulcers in Gaza Strip: a case-control study. *Int J Diabetes Res* 2015; 4: 1–6.
- Boyko EJ, Ahroni JH, Stensel V, Forsberg RC, Davignon DR, Smith DG. A prospective study of risk factors for diabetic foot ulcer. The Seattle Diabetic Foot Study. *Diabetes Care* 1999; 22: 1036–42.
- Tabar MG, Abdul-Wahab SZ. Diabetic foot causes and outcomes: a study in Wasit province, Iraq. *Wasit J Sci Med* 2014; 7: 116–27.
- Madanchi N, Tabatabaei-Malazy O, Pajouhi M. Who are diabetic foot patients? A descriptive study on 873 patients. *J Diabetes Metab Disord* 2013; 12: 36.
- Nehring P, Mrozikiewicz RB, Krzyzewska M. Diabetic foot risk factors in type 2 diabetes patients: a cross-sectional case control study. *J Diabetes Metab Disord* 2014; 13: 79.
- Al-Maskari FM. Prevalence of risk factors for diabetic foot complications. *BMC Fam Pract* 2007; 8: 59.
- Al-Asadi JN, Salih N. Herbal remedies use among diabetic patients in Nassyria, Iraq. *Mid East J Fam Med* 2012; 10: 40–46.
- Rizk MN, Ameen AI. Comorbidities associated with Egyptian diabetic foot disease subtypes. *Egypt J Intern Med* 2013; 25: 154–8.
- Doupis J, Grigoropoulou P, Voulgari C. High rates of comorbid conditions in patients with type 2 diabetes and foot ulcers. *Wounds* 2008; 20: 132–8.
- Bikramjit P, Swapan C, Kumar GS. An observational study on the correlation of the severity of diabetic foot ulcer disease with the socio-demographic profile and concomitant presence of hypertension and dyslipidemia in an urban population of India. *Int J Med Appl Sci* 2015; 4: 267–77.
- Parchman ML, Pugh JA, Romero RL. Competing demands or clinical inertia: the case of elevated glycosylated hemoglobin. *Ann Fam Med* 2007; 5: 196–201.
- Alan MD. Improving patient adherence. *Clin Diabetes* 2006; 24: 71–77.
- Singh N, Armstrong DG, Lipsky BA. Preventing foot ulcers in patients with diabetes. *JAMA* 2005; 2: 217–28.

22. Shailesh KS, Ashok K, Sushil K. Prevalence of diabetic foot ulcer and associated risk factors in diabetic patients from north India. *J Diabet Foot Complic* 2012; 4: 83–91.
23. Fonseca VA. Defining and characterizing the progression of type 2 diabetes. *Diabetes Care* 2009; 32: S151–6.
24. Kiley DJ, Lam CS, Pollak R. A study of treatment compliance following kidney transplantation. *Transplantation* 1993; 55: 51–56.
25. Bohn B, Herbst A, Pfeifer MI. Impact of physical activity on glycemic control and prevalence of cardiovascular risk factors in adults with Type 1 diabetes: a cross-sectional multicenter study of 18,028 patients. *Diabetes Care* 2015; 38: 1536–43. doi: <http://dx.doi.org/10.2337/dc15-0030>
26. Mikhael EM, Alhilai DN, Almutawali BZ. The reliability and accuracy of medical and pharmaceutical information that were given by drug companies through medical representatives to Iraqi physicians. *Int J Pharm Pharm Sci* 2014; 6: 627–30.
27. Jeffcoate WJ, Harding KG. Diabetic foot ulcers. *Lancet* 2003; 361: 1545–51.
28. Helgeson VS, Honcharuk E, Becker D. A focus on blood glucose monitoring: relation to glycemic control and determinants of frequency. *Pediatr Diabetes* 2011; 12: 25–30.
29. Mehmood K, Akhtar ST, Talib A. Clinical profile and management outcome of diabetic foot ulcers in a tertiary care hospital. *J Coll Physicians Surg Pak* 2008; 18: 408–12.

Appendix A

Diabetic patient questionnaire

Dear patient,

Hope you are well.

This questionnaire aims to find out the main causes behind developing diabetic foot ulceration among Iraqi diabetic patients. If you like the idea and accept to help us in this regard, please fill in the following questions:

General patient information

Age:

Sex:

Educational level:

Presence of comorbid conditions (like hypertension, angina, renal failure, etc.):

(a) Yes

(b) No

General diabetic information

1. Duration of diabetes?

(a) Less than 5 years

(b) Between 5 and 10 years

(c) More than 10 years

2. Do you know the risks and complication of the disease if you do not adhere with your treatment?

(a) Yes

(b) No

3. Do you know the symptoms of hyperglycemia?

(a) Yes (mention them)

(b) No

4. Do you have a domestic sugar screening device?

(a) Yes

(b) No

If your answer is “No,” then why?

(a) I cannot buy it

(b) I cannot buy the strips because they are expensive

5. How often do you scan your blood sugar level?

(a) At least once a day

(b) At least once weekly

(c) Rarely (less than two times/month)

6. Do you visit your physician regularly for evaluation and treatment of your diabetes?

(a) Yes

(b) No

(c) Rarely (in emergency cases)

7. Medicines that you are using to treat diabetes:

(a) Oral hypoglycemic to reduce the sugar

(b) Insulin

(c) Both

8. Is there any person who helps you to take control of your disease and its treatment?

(a) Yes

(b) No

9. Are you always adherent to your prescribed treatment in regard to dose and dosing frequency?

(a) Yes

(b) No

10. Source of your medical treatment

(a) A community pharmacy (if you choose this answer then please go directly to question 13)

(b) Public health centers (if you choose this answer then please answer all the following questions)

11. If you take your treatment from the public clinics, so is it always available?

(a) Yes

(b) No

For those who answered No, please answer the following question

12. If your treatment is not available in the public center, so will you stop using your treatment and not try to purchase it from private pharmacies?

(a) Yes

(b) No

13. Do you monitor your foot on an ongoing basis and to verify the absence of bruises and injuries?

- (a) Yes
- (b) No

14. Do you do physical activity (like running, walking, gymnastics, etc.) on a regular basis?

- (a) Yes
- (b) No

15. Have you suffered from diabetic foot ulceration in the past?

- (a) Yes
- (b) No

If you answered (yes) then answer the following question
How many times you got diabetic foot ulceration?
Please specify the number of attacks: