American Journal of
Health, Medicine and Nursing Practice
(AJHMN)

RISK FACTORS LEADING TO MAJOR LOWER LIMB AMPUTATIONS IN DIABETIC PATIENTS WITH FOOT ULCERS

Kamran Hakeem Khan, Fazal Ghani, Kamran Ahmad, and Mudassir Shahzad

American Journal of Health, Medicine and Nursing Practice
ISSN 2520-4017 (Online)
Vol.7, Issue 3, pp 26 – 32, 2022
www.ajpojournals.org

RISK FACTORS LEADING TO MAJOR LOWER LIMB AMPUTATIONS IN DIABETIC PATIENTS WITH FOOT ULCERS

[1]*Kamran Hakeem Khan, [2]Fazal Ghani, [3]Kamran Ahmad, [4]Mudassir Shahzad

[1,2,3,4]Assistant Professor, General Surgery, Qazi Hussain Ahmad Medical Complex, Nowshegra KPK, Pakistan

***Corresponding Author's Email:kamranhakeemkhan@gmail.com**

ABSTRACT

Purpose: Foot ulceration in persons with diabetes is the most frequent precursor to amputation, which impairs their activities. The aim of this study was to describe factors that lead to amputation of a diabetic foot, and propose a management strategy to prevent major amputation.

Methods: Cross-sectional study was conducted at the Qazi Hussain Ahmad Hosptial, Nowshera Pakistan, from Jan, 2016, July 2021, and comprised patients of either gender having type 1 or type 2 diabetes and foot ulcers. The wounds were assessed according to Wagner wound staging and wound sepsis was evaluated in terms of local infection of the wound, leukocytosis and osteomyelitis of the bone. The glycemic control of these patients was assessed on presentation by measuring glaciated hemoglobin levels. Data was analyzed using SPSS 22.

Findings: Out Of the 450 patients, 263(60%) were males and 187(40%) were females. Majority patients 193(43%) were aged 40-70 years. All 450(100%) patients underwent some type of amputation. Of all the amputations, 301(67%) were done in patients with poor glycaemic control on presentation, and 187(41%) in those with stage 4 wound. Local wound infection, increased total leukocyte count and bone showing features of osteomyelitis were significantly associated with increased risk of lower extremity amputations ($p<0.05$).

Conclusion: With the proper glycemic control and early presentation and treatment, majority of amputations could be avoided in diabetic patients with foot ulcers.

Keywords: *Minor amputation, debridement, diabetic patients, foot ulcers*

Introduction

Foot ulcers affect one in ten diabetics during their life- time.[1] Patients with diabetes have increased risk of lower-extremity amputations and the main cause is diabetic peripheral arterial disease accelerated by the direct damage to the nerves and blood vessels by high blood glucose levels. Wound healing is also impaired from affected collagen synthesis.[2,3] Diabetic vascular disease has three main components: arteritis and small vessel thrombosis; neuropathy (possibly is chaemic in cause); and large vessel atherosclerosis. DFU is a relatively common complication and potentially preventable complication of diabetes mellitus (DM). The chances for a patient having diabetes to experience DFU is about 24%. DFU is considered the major factor for lower extremity amputations in diabetics along with diabetic foot gangrene (DFG). It has been estimated that about 65% of lower extremity amputations are performed on diabetics and around 82% of patients initially have foot ulceration which further proceeds to lower limb amputations. In short, among diabetics, 23% develop foot ulcer during lifetime and in those patients with foot ulceration the risk of lower extremity amputation increases to 15 times as compared to non- diabetics. Limb amputation is a major life-changing decision for the patient that results in long-term physical, social, psychological and environmental changes.

Diabetic foot wound is a major health issue and it also causes socioeconomic stress on patients and their families due to long hospital stay and time for rehabilitation. Therefore, early recognition and proper management of risk factors of amputations in DFU patient may prevent major amputations and their adverse impacts.[4] In the western countries, the incidence of amputation inpatients with diabetic foot wounds has declined mostly due to early detection of the risk factors,[5] but in the developing countries, like Pakistan, amputation is a serious problem for diabetics. Low literacy level and late presentation to healthcare facilities are the main causes that lead to amputation in such patients·[6,7,8] Majority of the patients reach tertiary care hospitals after getting treatment from quacks foryears and once their wounds gets infected irreversibly they approach tertiary care hospitals where there is no other option left than to do amputation to stop the progression of the disease and to save the life of the patient.[6]

To assess the risk factors for amputations, a more precise prognosis for diabetic foot (DF) patients is critical at an early age.[9,10] Very few studies has assessed the risk factors for amputations in DF patients. In some studies, gangrene on admission, insulin-dependent diabetes, age >15 and < 70 years, and peripheral arterial disease (PAD) were among the proven factors for amputation in diabetics.[11,12,13]

There is little data available in Pakistan about the early minor amputation vs debridement and risk amputation in diabetic patients with foot ulcers has developed in diabetic patients. [15,16,]The current study was planned to evaluate riskfactors that lead to major lower extremity amputations in DFU patients.

Patients methodology

Cross-sectional study was conducted at the Qazi Hussain Ahmad Hosptial, Nowshera, Pakistan, from September 2016 to October 2021. The hospital is a tertiary care facility in the province of KPK. After approval from the institutional review board, the sample size of 450 was raised using consecutive non-probability sampling technique. All those diabetesmellitus types 1 man and 2 woman patients were selected who presented in outpatient department (OPD) or the emergency department (ED) and were of either gender aged >15 years

Patients were assessed on the basis of Wagner stage of diabetic ulcer classification,[9] wound sepsis was

confirmed by leucocytosis, local wound infection was assessed by sign of inflammation, like redness, hot, swelling, pain and loss of function, and osteomyelitis was assessed by X-ray findings of bone and glycaemic control on presentation. Complete blood count (CBC) was done to see the total leukocyte levels. Total leukocyte count >14 x 103cm3 was considered a sign of sepsis. Digital X-ray of the lower limb was performed in all patients to see the features of osteomyelitis in the bone, including the central area of radiolucency with a surrounding thick rim or reactive bone sclerosis, tortuous parallel lucent channels extending towards the growth plate and variable degree of periosteal new bone formation.[10] Glycatedhaemoglobin (HbA1c) values were noted at baseline, andHbA1c >6.5% was taken as poor glycaemic control. Risk factors leading to amputations were assessed on the basis of above-mentioned parameters. Outcome was calculated in terms of procedure done on presentation, the patients was taken on a preformed proforma after describing them the nature of the disease and nature of research work and signature were taken from all patients.

Data was analyzed using SPSS 22. Quantitative variables were presented as mean ± standard deviation (SD), and qualitative variables were presented as frequencies and percentages. Categorical data analysis was done using chi- square test and student's t-test. $P<0.05$ was considered statistically significant.

Results

Of the 450 patients, 263(60%) were males and 187(40%) were females. Majority patients 193(43%) were aged 40-70 years. All 450(100%) patients underwent some type of amputation (Table-1). Of all the amputations, 301(67%) were done in patients with poor glycaemic control on presentation, and 187(41%) in those with stage 3 to 4 wound.

Table 1: Results of demographic Age groups and glycaemic control.

Age Group on Presentation	Male	Female	Total
15-29 (years)	38 (8.48 %)	0 (0.0 %)	38 (8.48%)
30-40 (years)	67 (12.59 %)	15 (6.70 %)	78 (19.2%)
40-50 (years)	81 (17.77 %)	13 (9.62 %)	94 (42.4%)
50-60 (years)	182 (40.2 %)	24 (17.77 %)	206 (57.7%)
60-70 (years)	18 (2.96 %)	11 (8.14 %)	29 (11.11%)
Total	130 (30.7 %)	53 (39.2 %)	
Glycaemic control on presentation	**Male Amputations**	**Female Amputation**	
HbA1c < 7 %	91 (34.1 %)	59 (30.1 %)	
HbA1c > 7 %	162 (65.85%)	128 (69.81%)	
Total	263	187	450
HbA1c: Gyrated hemoglobin.			

American Journal of Health, Medicine and Nursing Practice
ISSN 2520-4017 (Online)
Vol.7, Issue 3, pp 26 – 32, 2022
www.ajpojournals.org

Table 2: results of Wagner staging of wounds.

Wagner stage	Male Amputations		Female Amputations		Total on presentation
1	22 (8.53 %)	6 RA	5 (3.77%)	2 RA	8 RA
		1 BKA			1 BKA
2	32 (13.41%)	4 RA	61 (30.18%)	10 RA	14 RA
		7 BKA		6 BKA	13 BKA
3	106 (41.46%)	14 RA	77 (41.5%)	15 RA	29 RA
		19 BKA		6 BKA	25 BKA
		1 AKA		1 AKA	2 AKA
4	103 (36.58%)	4 RA	44 (24.52%)	4 RA	8 RA
		19 BKA		7 BKA	26 BKA
		7 AKA		2 AKA	9 AKA
Total	263	**83 RA (28.00 %)**	**187**	**130 RA (58.4 %)**	**450**
		120 BKA (51.21 %)		**67 BKA (35.8 %)**	
		26 AKA (9.75 %)		**11 AKA (5.66 %)**	

RA: Ray amputation, BKA: Below-knee amputation, AKA: Above-knee amputation.

On table 2 table Wagner staging of wounds are including ray amputation (RA), below-knee amputation (BKA) andabove-knee amputation (AKA). Clinically, foot wound ulcer was assessed according to the International Working Group on Diabetic Foot Guidelines by the existence of exudate on the wound which is mostly purulent or any two of the following factors: edema, redness and local warmth around the wound, foul smelling discharge, palpation pain, tenderness around the wound, and fever.[11] All patients underwent multi- disciplinary care, including complete bed rest, wound debridement, daily wound dressing, antibiotic therapy and appropriate amputation in addition to controlof blood glucose. In the absence of any generally recognized criteria for classification of amputation as major or minor, for the purpose of the current study, major amputation was defined as amputation above the metatarsal bone involvingthe big toe, otherwise it was categorized as minor amputation.

Table 3: Results of the wound sepsis

Wound condition on presentation	Male Amputation		Female Amputation		Total	P -Value
Local infection	263 (58.63%)	9 RA	187 (42.45%)	12 RA	20 RA	**0.04**
		11 BKA		5 BKA	16 BKA	
		2 AKA		2 AKA	4 AKA	
Leukocytosis	66 (52.2%)	6 RA	39 (48.58%)	4 RA	10 RA	**0.01**
		7 BKA		3 BKA	7 BKA	
Osteomyelitis	131 (66.8%)	8 RA	42 (41.05%)	16 RA	14 RA	**0.024**
		31 BKA		11 BKA	26 BKA	
		8 AKA			8 AKA	
Total	263	23 RA	187	32 RA		
		49 BKA		19 BKA		
		10 AKA		2 AKA		

Discussion

DM is considered one of the biggest contributing factors for major leg amputations as it increases the amputation rate 15-20 times. Not much literature is available in terms of evaluation of the risk factors for major amputations in diabetics. One study identified Wagner grade, congestive heart failure (CHF), leukocytosis, dementia and peripheral arterial occlusive disease (PAOD) as significant risk factors for amputations in diabetics.[18] The current study identified and evaluated predictors of amputations in diabetics, like Wagner classification grade of DFU, wound sepsis, including local infection, leukocytosis and osteomyelitis, and basal glucose level control. It was found that good control of all parameters seemed to prevent major amputations in DFU patients. Wound state at presentation, according to Wagner grade, was the principal predictor for major amputations in all patients living with diabetes as a previous study has clearly reported the significant correlation between Wagner grading and DF amputations. The current study revealed that wound sepsis, including local infection along with leukocytosis and deep tissue infection in the form of osteomyelitis, were major risk factors. Osteomyelitis is the sole augmenting factor for amputation in DF patients although different types of surgical wound care are available to prevent the spread of the foot ulcer deep into the tissues. Wound care has also got important role in the management of diabetic ulcer on foot, which includes wound wash with normal saline and the use of latest wound management equipment. Also, many topical medicines are present that have shown promising results in the management of DF wounds depending upon patient's general health, wound state and process of tissue repair.[19]

According to a study, the most significant predictors for lower extremity amputation are osteomyelitis (p=0.0114), retinopathy (p=0.0001) and neuropathy (p=0.0001).[16] The findings of the current study are similar. In addition, poor glycaemic control is one of the major contributors for non-healing ulcers and amputations. Good glycaemic control is important to reduce amputation risk in diabetics.[17] HbA1c was measured at the time of presentation of

patients and value >6.5% was considered poor glycaemic control. A study said HbA1c can be effectively used as lavatory parameter in DFU patients, and it can be used as a target to reduce amputation rates.[18]

The current study has some limitations. First, the number of DFU patients was small which may explain the relatively higher rates of amputations observed. Moreover, the duration of study was not long enough to establish statistically significant relationship of the identified risk factors. In addition, PAOD of patients was not taken into account which is already identified as a separate risk factor of amputation in DFU patients.

Conclusion

Wound sepsis, Wagner grade and poor glycaemic controlwere found to be major risk factors of amputation in DFU patients. Good attention and minimization of these factors may prevent major amputations in DFU patients. Patient education about self-wound care, early mobilization and proper glycaemic control were found to be the essentials for DFU management.

References

1. Shatnawi NJ, Al-Zoubi NA, Hawamdeh HM, Khader YS, Garaibeh K,Heis HA. Predictors of major lower limb amputation in type 2 diabetic patients referred for hospital care with diabetic foot syndrome. Diabetes Metab Syndr Obes. 2018; 11:313-9.

2.Shin JY, Roh SG, Lee NH, Yang KM. Influence of epidemiologic and patient behavior–related predictors on amputation rates in diabetic patients: Systematic review and meta-analysis. Int J LowExtrem Wounds. 2017; 16:14-22.

3.Yasin M, Zafar S, Rahman H, Khan TA, Nazir S, Shah S, et al. Baseline characteristics of infected foot ulcers in patients with diabetes at a tertiary care hospital in Pakistan. 2018; 27:S26-S32.

4. Smith AD, Hawkins AT, Schaumeier MJ, de Vos MS, Conte MS, Nguyen LL. Predictors of major amputation despite patent bypass grafts. J Vasc Surg. 2016; 63:1279-88.

5. Usman K, Khan S, Iftikhar M, Khattak TG. Glycosylated HemoglobinAs Predictor For Lower Extremity Amputation In Diabetic Patients. Gomal J Med Sci. 2017; 15:16-20.

6. Acar E, Kacıra BK. Predictors of lower extremity amputation andreamputation associated with the diabetic foot. J Foot Ankle Surg. 2017; 56:1218-22.

7. Betman MJ, Hulst I, van Dijk LC, van Overhagen H, van Eps RG, Veger HT, et al. Amputation in diabetic foot patients: a prediction model. Diabetic Foot J. 2018; 21:32-43.

8. Di Giovanni P, Scampoli P, Meo F, Cedrone F, D'Addezio M, Di Martino G, et al. The impact of gender on diabetes-related lower extremity amputations: An Italian regional analysis on trends and predictors. Foot Ankle Surg. 2020.

9. Ferreira L, Carvalho A, Carvalho R. Short-term predictors of amputation in patients with diabetic foot ulcers. Diabetes & Metabolic Syndrome: Clin Res Rev. 2018;12:875-9.

10. Hickson LJ, Rule AD, Thorsteinsdottir B, Shields RC, Porter IE, Fleming MD, et al. Predictors of early mortality and readmissions among dialysis patients undergoing lower extremity amputation. J Vasc Surg. 2018; 68:1505-16.

11. Jeong EG, Cho SS, Lee SH, Lee KM, Woo SK, Kang Y, et al. Depth and combined infection is important predictor of lower extremity amputations in hospitalized diabetic foot ulcer patients. Korean JIntern Med. 2018; 33:952-60.

12. Kaneko M, Fujihara K, Yamamoto M, Kitazawa M, Ishizawa M, Osawa T, et al. Incidence and Risk Factors for Amputation in Patients with Diabetes in Japan-Historical Cohort Study Using a Nationwide Claims Database. Am Diabetes Assoc; 2018; 67:11-32.

13.Kaplan S, Hemsinli D, Kaplan S, Arslan A. Amputation predictors in diabetic foot ulcers treated with hyperbaric oxygen. J Wound Care. 2017; 26:361-6.

14. Mehraj M, Shah I. A review of Wagner classification and current concepts in management of diabetic Foot. Int J Ortho Sci. 2018;

15.Kim JL, Shin JY, Roh SG, Chang SC, Lee NH. Predictive laboratory findings of lower extremity amputation in diabetic patients: meta- analysis. Int J Low Extrem wounds. 2017; 16:260-8.

16. Sayiner Z, Can F, Akarsu E. Patients' clinical characteristics and predictors for diabetic foot amputation. Prim Care Diabetes. 2019; 13:247-51.

17. Kim SY, Kim TH, Choi JY, Kwon YJ, Choi DH, Kim KC, et al. Predictors for amputation in patients with diabetic foot wound. Vasc Specialist Int. 2018; 34:109-16.

18. Sen P, Demirdal T, Emir B. Meta- analysis of risk factors for amputation in diabetic foot infections. Diabetes Metab Res Rev. 2019; 35:e3165.