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Original Research Article

Evaluating risk factors and surgical outcomes in diabetic foot patients at a tertiary care hospital

Shyamal Kumar Roy[1]*, Dipu[2], Rumana Parveen[3], Tauhidul Islam[4], Asif Aman[2], M. Meher Ullah[5], Satya Ranjan Mondal[6], A. K. M. Mustakim Billah[6], M. Khalid Bin Rahman Apourba[7]

[1]Department of Lab, Institute of Public Health and Nutrition (IPHN), Dhaka, Bangladesh
[2]Department of Surgery, Shaheed Monsur Ali Medical College Hospital, Dhaka, Bangladesh
[3]Casualty Block of Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[4]Department of Surgery, IBN SINA Hospital, Dhanmondi, Dhaka, Bangladesh
[5]Department of Surgery, Shatkhira Medical College Hospital, Shathkhira, Bangladesh
[6]Department of Surgery, Bangladesh Medical College, Dhaka, Bangladesh
[7]Department of Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh

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***Correspondence:**
Dr. Shyamal Kumar Roy,
E-mail: dr.shyamalbd@gmail.com

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ABSTRACT

Background: Diabetic foot disease is a serious and common complication of diabetes, often leading to chronic ulcers, infections and lower limb amputations. This study aims to assess the clinical outcomes of surgical interventions and identify key risk factors influencing prognosis in diabetic foot patients treated at a tertiary care hospital. The aim of the study was to evaluate the clinical outcomes of surgical interventions and identify key risk factors influencing prognosis in diabetic foot patients treated at a tertiary care hospital.

Methods: This prospective observational study at the Department of Surgery and SOPD, Dhaka Medical College Hospital (January-December 2018), included 73 diabetic foot patients aged 20–80 years, excluding those with renal failure, chronic liver disease or malignancy. After ethical approval and consent, data on clinical features, treatments and outcomes were collected alongside relevant investigations. Patients were followed every two months post-discharge. Data were analyzed using SPSS v22 with significance at $p<0.05$.

Results: Of 73 diabetic foot patients (mean age 51 years), most were male (61.6%) with diabetes duration of 1–5 years. Ulcer was the main complaint (71.2%). Uncontrolled diabetes (65.8%) and elevated HbA1c (58.9%) were common. Key risk factors included neuropathy (64.4%) and hyperlipidaemia (63.0%). Surgical treatment was significantly associated with poor glycemic control ($p<0.001$), with highest recovery seen after debridement and reconstruction (89.3%).

Conclusions: Uncontrolled diabetes and associated risk factors significantly influence the need for surgical intervention and affect outcomes in diabetic foot patients.

Keywords: Diabetic foot, Risk factors, Surgical outcomes

INTRODUCTION

Diabetes is a chronic condition that significantly affects overall health and, if poorly managed, can lead to serious complications.[1] As per the International Diabetes Federation's 2019 report, an estimated 463 million adults aged 20–79 were living with diabetes, with projections suggesting this number could rise to 700 million by 2045.[2] Among the many complications, foot problems are particularly common. Diabetic foot disease refers to infection, ulceration or tissue damage in the foot of a person with diabetes, typically linked to peripheral

neuropathy and/or peripheral arterial disease.[3] Approximately 15% of diabetic patients may develop foot ulcers, making this the most frequent precursor to lower limb amputation.[4-6] Such complications can be severely disabling or even life-threatening and diabetic foot disease remains a major cause of both hospitalization and amputation in this population. Diabetic foot ulcers (DFUs) are often chronic in nature, prone to recurrence and carry a high risk of infection, which can ultimately lead to limb amputation.[7,8]

Patients with diabetic foot complications have a higher mortality rate compared to those without such issues.[9] A substantial proportion of these patients require surgical management, contributing to increased hospital admissions and prolonged inpatient stays. In India, DFUs are responsible for nearly 80% of all nontraumatic amputations annually. On average, the healing time for a diabetic foot ulcer is around 28 weeks. Financially, the burden is immense an estimated 5.7 years of a patient's income may be needed to cover the full cost of DFU treatment.[10] Moreover, longitudinal epidemiological studies have shown that approximately 25% of individuals with diabetes are at risk of developing a foot ulcer during their lifetime.[11]

Common factors that increase the risk of amputation after the development of foot ulcers include peripheral vascular disease, advanced neuropathy, foot deformities and superimposed infections.[12,13] Diabetic individuals are particularly vulnerable to these complications, with diabetic neuropathy and peripheral vascular disease being the most significant contributors to the development of diabetic foot ulcers.[14] Peripheral neuropathy (PN) and peripheral vascular disease (PVD) are among the most frequently encountered diabetes-related complications.[15] Even in the absence of typical symptoms, patients with PN and PVD are considered high-risk for foot complications, underscoring the need for early detection and proactive management. When medical treatment for diabetic foot complications proves inadequate, advanced surgical interventions such as amputation become necessary.[16]

The increasing rate of amputations highlights the urgent need for preventive strategies and diligent foot care.[17] Lower Extremity Amputation (LEA) is 10 to 30 times more common in diabetic individuals than in those without diabetes.[18] Additionally, about 70% of all lower limb amputations occur in people with diabetes, with 85% of these cases preceded by foot ulceration.[19] While diabetic foot complications are well recognized, limited data exist on surgical outcomes and associated risk factors in tertiary care settings, especially in resource-constrained regions. Most research focuses on prevention or general management, with less attention to post-surgical prognosis. This study aims to assess the clinical outcomes of surgical interventions and identify key risk factors influencing prognosis in diabetic foot patients treated at a tertiary care hospital.

Objective

To evaluate the clinical outcomes of surgical interventions and identify key risk factors influencing prognosis in diabetic foot patients treated at a tertiary care hospital.

METHODS

This prospective, observational study was conducted at the Department of Surgery and Surgical Outpatient Department (SOPD) of Dhaka Medical College Hospital, Dhaka, Bangladesh between January 2018 and December 2018. A total of 73 diabetic foot patients were included in the study, selected based on predefined inclusion criteria for evaluating surgical outcomes and risk factors in diabetic foot management.

Inclusion criteria

Patients diagnosed with diabetes mellitus presenting with foot complications. Age between 20 to 80 years, regardless of sex.

Exclusion criteria

Patients with renal insufficiency requiring hemodialysis. Patients diagnosed with chronic liver disease (CLD). Patients with any known malignancy.

After enrollment, ethical clearance was obtained from the institutional review board of Dhaka Medical College Hospital and informed written consent was collected from all participants. Data were gathered using a structured proforma documenting sociodemographic details, medical and surgical history, post-operative outcomes and follow-up status. Variables assessed included duration and type of diabetes, characteristics of diabetic foot ulcers, comorbidities, surgical interventions and treatment outcomes.

Relevant investigations such as CBC, ESR, fasting and postprandial blood glucose, HbA1c, urine ketones, ECG, X-ray, Doppler studies and wound culture sensitivity were performed. Follow-up was conducted every two months post-discharge in the surgical OPD, including clinical evaluations and laboratory tests. Data were manually edited, entered into SPSS version 22 and analyzed. Continuous variables were expressed as mean±SD and compared using unpaired t-tests; categorical data were presented as percentages and analyzed with Chi-square tests.

A p value of <0.05 was considered statistically significant. Key terms such as diabetes mellitus, diabetic foot and surgical complications were defined using standard operational definitions. The study utilized the existing clinical, laboratory and imaging facilities of Dhaka Medical College Hospital. Ethical conduct was ensured in accordance with the Declaration of Helsinki,

maintaining participant confidentiality, voluntary participation and minimizing physical or psychological risks throughout the study.

RESULTS

Table 1 shows the demographic and clinical characteristics of the diabetic foot patients. The age range of the patients was between 20–80 years, with a mean±SD of 51.0±13.5 years. The majority (56.2%) of patients were between 41–60 years of age, followed by 23.3% aged 20–40 years and 20.5% aged 61 years or older. Regarding sex distribution, 61.6% were male and 38.4% were female. Most patients (61.6%) had a duration of diabetes mellitus between 1 to 5 years, while 23.3% had 6–10 years and 15.1% had diabetes for more than 10 years. Table 2 shows the distribution of patients according to their presenting complaints. The most common presentation was ulcer, observed in 71.2% of the patients. This was followed by black skin with swelling in 15.1% and swelling alone in 13.7% of the cases. Table 3 presents the glycemic profile of the patients based on HbA1c levels and diabetes control status. Among the study population, 58.9% had increased HbA1c levels, while 41.1% had normal levels. In terms of diabetes control, 65.8% of patients were found to have uncontrolled diabetes and 34.2% had controlled diabetes.

Table 4 shows the distribution of diabetic foot patients according to associated risk factors. Peripheral neuropathy was the most common risk factor, present in 64.4% of patients, followed closely by hyperlipidaemia (63.0%) and hypertension (58.9%). Other notable risk factors included smoking (47.9%), obesity (43.8%) and betel nut consumption (26.0%). Table 5 demonstrates the distribution of treatment modalities based on the glycemic status of the patients.

Among those with controlled diabetes, 56.0% were managed conservatively and 44.0% underwent surgical intervention. In contrast, 85.4% of the patients with uncontrolled diabetes required surgical treatment, while only 14.6% were treated conservatively. The difference in treatment approach based on glycemic control was statistically significant ($p<0.001$).

Table 6 presents the outcome of different treatment modalities used in the management of diabetic foot patients. Among those treated conservatively, 76.2% recovered, while 23.8% did not recover within the follow-up period. In the surgical group, 83.3% of patients who underwent incision, drainage and dressing recovered and 89.3% of those who had wound debridement, dressing and reconstruction recovered. Similarly, 83.3% of patients who underwent amputation also recovered.

Table 1: Demographic and clinical characteristics of the patients (n=73).

Variable		Number of patients	%
Age (in years)	20–40	17	23.3
	41–60	41	56.2
	≥61	15	20.5
	Mean±SD	51.0±13.5	
	Range	20–80 years	
Sex	Male	45	61.6
	Female	28	38.4
Duration of DM in years	1–5	45	61.6
	6–10	17	23.3
	>10	11	15.1

Table 2: Distribution of the patients by presenting complaints (n=73).

Presenting complaint	Number of patients	%
Ulcer	52	71.2
Black skin with swelling	11	15.1
Swelling	10	13.7
Total	73	100.0

Table 3: Glycemic profile of the patients (n=73).

Glycemic parameter		Number of patients	%
HbA1c level	Normal	30	41.1
	Increased	43	58.9
Status of diabetes	Controlled	25	34.2
	Uncontrolled	48	65.8

Table 4: Distribution of the patients by risk factors (n=73).

Risk factor	Number of patients	(%)
Peripheral neuropathy	47	64.4
Hyperlipidaemia	46	63.0
Hypertension	43	58.9
Smoking	35	47.9
Obesity	32	43.8
Betel nut consumption	19	26.0

Table 5: Management plan according to glycemic status of the patients (n=73).

Management plan	Controlled diabetes (n=25)	Uncontrolled diabetes (n=48)	Total (n=73)	P value
Conservative	14 (56.0%)	7 (14.6%)	21 (28.8%)	<0.001*
Surgical	11 (44.0%)	41 (85.4%)	52 (71.2%)	
Total	25 (100.0%)	48 (100.0%)	73 (100.0%)	

* - Significant

Table 6: Evaluation of treatment modalities and outcomes among diabetic foot patients (n=73).

Treatment Modality	N	Recovered (n, %)	Not recovered (N, %)
Conservative	21	16 (76.2)	5 (23.8)
Surgical			
Incision, drainage and dressing	18	15 (83.3)	3 (16.7)
Wound debridement, dressing and reconstruction	28	25 (89.3)	3 (10.7)
Amputation	6	5 (83.3)	1 (16.7)

DISCUSSION

Diabetic foot complications remain a major cause of morbidity and hospital admissions among patients with diabetes in tertiary care settings. This study highlights the clinical outcomes and key risk factors associated with diabetic foot disease in patients treated at a tertiary care hospital in Bangladesh. The findings emphasize the multifactorial nature of diabetic foot complications, with factors such as peripheral neuropathy, poor glycemic control and vascular disease contributing to prognosis. The observed surgical outcomes and complication rates underscore the importance of early risk identification and comprehensive management to improve patient recovery and reduce morbidity.

In the current study, most patients presenting with diabetic foot complications were between 41 and 60 years of age (56.2%), with a mean age of 51.0±13.5 years. These findings are consistent with those of Mohamed et al, who noted the highest prevalence within the 51–60 age range (57.23%). Males constituted a higher proportion (61.6%) compared to females (38.4%), which contrasts with Mohamed et al's, observation of slightly higher female prevalence (52.02%).[20] Regarding duration of diabetes, 38.4% of patients had diabetes for more than 5 years in this study, reinforcing the association between longer disease duration and diabetic foot complications, as supported by Mohamed et al, who identified prolonged disease duration as a contributing factor and Younis et al who found that 75.8% of foot ulcer patients had diabetes for over 6 years.[20,21] These findings emphasize that middle-aged individuals, particularly males and those with longer durations of diabetes, are at increased risk for developing diabetic foot problems.

In the study, ulcer was the most frequent presenting complaint among diabetic foot patients, observed in 71.2% of cases. This finding aligns with the results of Qari et al, who reported foot ulcer as the most common presentation in 59% of their diabetic patients.[22] The predominance of ulceration highlights its role as a key clinical feature in diabetic foot, often preceding more severe complications. Other presenting symptoms in our cohort included black skin with swelling (15.1%) and swelling alone (13.7%), further emphasizing the diverse yet progressive manifestations of diabetic foot complications.

In this study, the majority of diabetic foot patients exhibited poor glycemic control, with 58.9% having elevated HbA1c levels and 65.8% classified as having uncontrolled diabetes. These findings are consistent with the results of Danesh et al, who reported that 76.9% of patients in the ulcer group had moderate to poor glycemic control (HbA1c≥7%).[23] Similarly, Abdulghani et al, found that 32.5% of patients had highly uncontrolled HbA1c (≥8.6%) and noted a strong association between poor glycemic control and diabetic foot complications, with an odds ratio of 8.09.[24] These similarities highlight the critical role of glycemic regulation in preventing the onset and progression of diabetic foot conditions and

reinforce the need for targeted interventions to maintain optimal blood glucose levels in this high-risk population. In the present study, peripheral neuropathy was the most common risk factor, affecting 64.4% of patients, which is in line with findings by Alshammari et al, who reported a wide prevalence range of diabetic neuropathy from 25% to over 90%, with approximately 40% presenting with peripheral neuropathy.[25] Other metabolic risk factors such as hyperlipidaemia (63.0%), hypertension (58.9%) and obesity (43.8%) were also highly prevalent in our sample and are similarly recognized by Alshammari et al, as contributing factors associated with diabetic neuropathy.[25]

Additionally, 47.9% of patients had a history of smoking, a known contributor to peripheral vascular disease and delayed wound healing. Notably, 26.0% of the patients reported betel nut consumption, which has been linked to metabolic syndrome and elevated blood pressure in diabetic individuals, further emphasizing its potential role in exacerbating diabetic foot complications.[26] These findings underscore the multifactorial nature of diabetic foot pathology and highlight the importance of identifying and addressing modifiable risk factors in clinical management.

In this study, patients with uncontrolled diabetes were significantly more likely to undergo surgical management (85.4%) compared to those with controlled diabetes (44.0%), while conservative treatment was more common in the controlled group (56.0% vs. 14.6%, $p<0.001$). These findings align with Hasan et al, who reported that better glycemic control may reduce the risk of amputation and the need for surgical interventions in patients with diabetic foot syndrome.[27] This emphasizes the critical role of maintaining adequate glycemic control to potentially minimize invasive procedures and improve patient outcomes in diabetic foot management.

Our study demonstrated higher recovery rates with surgical interventions compared to conservative management for diabetic foot ulcers. Conservative treatment showed a 76.2% recovery rate, while surgical modalities such as incision and drainage (83.3%), wound debridement with reconstruction (89.3%) and amputation (83.3%) had better outcomes. These findings are consistent with Piaggesi et al who reported that surgical treatment of neuropathic foot ulcers resulted in higher healing rates and shorter healing times than conservative approaches.[28] Similarly, Yammine et al, found that surgical interventions significantly improved outcomes in both infected and noninfected neuropathic foot ulcers compared to nonsurgical methods.[29] This evidence underscores the importance of prompt surgical intervention in enhancing recovery outcomes for patients with diabetic foot complications.

The follow-up period was relatively short, which may have limited the evaluation of long-term surgical outcomes.

It was an observational study; a randomized controlled trial (RCT) could have provided stronger evidence. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Due to the low literacy levels and poor socioeconomic status of many patients, not all parameters related to treatment, follow-up and outcomes could be thoroughly assessed.

CONCLUSION

Diabetic foot complications remain a significant cause of morbidity, especially among patients with poor glycemic control and multiple comorbid risk factors. This study found that uncontrolled diabetes and factors such as peripheral neuropathy, hyperlipidaemia and hypertension were common among patients requiring surgical intervention. Surgical treatments, including wound debridement and amputation, demonstrated good recovery outcomes, reinforcing their importance in managing advanced cases. These results highlight the need for comprehensive management focusing on early risk factor identification, optimal glycemic control and timely surgical care in tertiary hospital settings to improve patient outcomes.

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