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Risk Factors and Surgical Debridements Outcome in Patients with Diabetic Foot Patients

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Abstract **Original Research Article**

Diabetic foot disease can be defined as infection, ulceration, or destruction of tissues of the foot of a person who is diagnosed with diabetes mellitus (DM) and which is usually associated with neuropathy and/or peripheral arterial disease in the lower extremity. To determine the risk factors for multiple surgical debridements in patients with diabetic foot ulcer, in comparison to one or no surgical debridement. This study is carried out in the Department of General & Laparoscopic Surgeon, International Medical College & Hospital, Tongi, Gazipur Dhaka, Bangladesh from February 2021 to June 2022. This is an observational study and data was collected retrospectively. A total of 100 patients were included in the study. 78% were elderly (> 50 years), 68% were men, and 33% were over-weight/obese. In this clinical study of diabetic foot ulcers, diabetic foot ulcer patients were evaluated and also assessed for risk factors for multiple repeated debridements, by comparing with patients who had one or none debridements. The risk factors identified among the patients who underwent multiple debridements were higher grade of Wagner diabetic foot ulcer classification, infections and poor nutrition (hypoalbuminemia). A thorough evaluation of diabetic foot ulcer utilizing a multidisciplinary team is recommended to achieve optimal outcomes.

Keywords: Diabetic Foot, Debridements, Foot Ulcer, Poor Nutrition.

INTRODUCTION

Diabetic foot disease can be defined as infection, ulceration, or destruction of tissues of the foot of a person who is diagnosed with diabetes mellitus (DM) and which is usually associated with neuropathy and/or peripheral arterial disease in the lower extremity [1]. A usual presentation involves a trauma to the foot due to loss of sensation, along with poor healing and neglect. This may further develop into ulcers and gangrene depending on how early the presentation was. When medical management for diabetic foot is insufficient, advanced surgical management like amputation will be required [2]. People with diabetes are between 15 and 70 times more likely to undergo lower limb amputations than people without diabetes [2]. Most patients who have an amputation have many admissions before and after surgeries with the average length of stay over 200 days. It is a huge economical burden, not just the hospital costs, but also taking into account, the personal costs to the patient, e.g. a reduction in ability to work; time taken off work; altered body image; worry and threat of amputation; dressing regimens and hospital visits. Debridement is the removal of devitalized, contaminated or foreign material from within or adjacent to a wound, until surrounding healthy tissue is exposed and it is widely practiced and regarded as an effective intervention to speed up ulcer healing in diabetic foot care [3]. Debridement is recommended by the sign diabetic foot guidelines alongside antibiotic therapy for infection and pressure relief as a treatment for patients who have developed ulceration or gangrene with risk of amputation. The rationale for debridement of diabetic foot ulcers are as it removes pressure from the edge of an ulcer providing an optimal opportunity for wound healing, exposes the full extent of the wound allowing a more detailed review of the size and depth and anatomical structures involved in the ulceration, enables a deep wound swab to be taken which is a more accurate method of determining the causative agent of any infection than the use of a superficial wound swab, and converts a chronic wound back to an acute wound, recreating an optimal wound healing environment [4].

MATERIALS & METHODS

This study is carried out in the Department of General & Laparoscopic Surgeon, International Medical College & Hospital, Tongi, Gazipur Dhaka, Bangladesh from February 2021 to June 2022. A total of 100 patients were included in the study. All diabetic patients with foot ulcers, who were admitted the inclusion criteria will be eligible for enrollment in the study. Patients clinical biochemical and radiological data is collected in the retrospective and prospective fashion as available.

Inclusion Criteria:

- Adult patients with Type 1 or 2 diabetes, with an active foot ulcer.

Exclusion Criteria:

- Age < 18 yrs.
- Shock,
- Sepsis,
- Presence of medical comorbidities (Respiratory failure, renal failure, cardiac fatalities such as MI, CHF, Coma) requiring ICU stay.

Patients with the above exclusion criteria are not included in the study. If the patient developed any of the medical comorbidities while in the hospital during the study period, he/she was excluded from the study. Data was divided into two groups: patients requiring one or no debridement and patients requiring multiple debridements. Statistical analysis is performed.

RESULTS

A total of 100 patients were included in the study. 78% were elderly (> 50 years), 68% were men, and 33% were over-weight/obese. Peripheral vascular disease was noted in 12.3% of study population. 78% of the patients were positive for bacterial culture from wound swab. A total of 39 (36%) patients underwent repeated multiple debridements. Mean hospital duration was 27 days. 18 patients underwent split thickness skin grafting before discharge.

Table-1: Demographics of data (N=100)

Variables	**N=100**
Age	58.1±- 9.0
Age	
<50 years	22 (22%)
51-60 years	39 (39%)
>60 years	39 (39%)
Gender	
Male	68 (68%)
Female	32 (32%)
Surgical Debridement	
≤ 1 debridement	64 (64%)
> 1 debridement	36 (36%)

Table-2: Vascular findings (N=100)

Vascular findings	**N=100**
Peripheral pulses absent in:	
Rt Femoral	1 (1%)
Lt Femoral	0
Rt Popliteal	11 (11%)
Lt Popliteal	12 (12%)
Rt DP	22 (22%)
Lt DP	19 (19%)
Rt PT	23(23%)
Lt PT	20 (20%)

Table-3: Ulcer findings (N=100)

Ulcer findings	**N=100**
Ulcer Size, cm	
Wagners Classification	
I	35 (35%)
II	29 (29%)
III	23 (23%)
IV	13 (13%)

Table-4: Distribution of infective organisms (N=100)

Infective Organisms	N=100
Moraxella	4 (4%)
Pseudomonas	23 (23%)
E.coli	25 (25%)
Klebsiella	9 (9%)
Staphylococcus	12 (12%)
Proteus	14 (14%)
GND	8 (8%)
Citrobacter	5 (5%)

Table-5: Nutritional findings (N=100)

Nutritional findings	N=100
BMI > 25	32 (32%)
S. Protein	5.8 ± 0.7
S. Albumin	3.0 ± 0.5

Table-6: Hematological and Biochemical Investigations (N=100)

Biochemical Investigations	N=100
HbA1c (g %)	9.9 ±2.7
Dyslipidemia	42 (42%)
S. Creatinine	1.0 ± 0.4
HB (g %)	9.3±1.7
WBC (cells/ccmm)	13,600 ±5000
ESR (mm/hr)	82.5±28.5

Table-7: Over all Outcomes (N=100)

Outcomes	N=100
Length of Hospital Stay (Days)	26.7±20.5
Skin grafting	18 (18%)

Table-8: Compare demographics ≤ 1 debridement vs. > 1 debridement (N=100)

	≤ 1 debridement N=65	> 1 debridement N=35	P-value
Age	57.7±9.6	58.7±7.9	0.63
Age			
< 50 years	15 (23.1%)	6 (17.1%)	0.69
51-60 years	24 (36.9%)	15 (42.9%)	
>60 years	26 (40.0%)	14 (40.0%)	
Gender			
Male	42 (64.6%)	26 (74.3%)	0.39
Female	23 (35.4%)	9 (25.7%)	

Table-9: Compare vascular findings: ≤ 1 debridement vs. > 1 debridement Vascular Factors (N=100)

Vascular Factors	≤ 1 debridement N=65	> 1 debridement N=35	P-value
Claudication Pain	14 (21.5%)	3 (8.6%)	0.06
Rest Pain	3 (4.6%)	-	0.17
Peripheral pulses absent in:			
Right Femoral	2 (3.1%)	0	1.0
Left Femoral	0	0	-
Right Popliteal	8 (12.3%)	3 (8.6%)	0.70
Left Popliteal	9 (13.8%)	2 (5.7%)	0.21
Right Dorsalis pedis	15 (23.1%)	8 (22.9%)	0.93
Left Dorsalis pedis	14 (21.5%)	6 (17.1%)	0.84
Right posterior tibial	15 (23.1%)	9 (25.7%)	0.56
Left posterior tibial	15 (23.1%)	7 (20.0%)	0.37

Table-10: Compare ulcer findings: ≤ 1 debridement vs. > 1 debridement (N=100)

	≤ 1 debridement N=65	> 1 debridement N=35	P-value
Ulcer Size (cm)	6.9±5.1	7.3±4.6	0.24
Wagners Classification			
I	32 (49.2%)	4 (11.4%)	< 0.0001
II	21 (32.3%)	8 (22.9%)	
III	10 (15.4%)	13 (37.1%)	
IV	2 (3.1%)	10 (28.6%)	

Table-11: Compare haematological and biochemical investigations: ≤ 1 debridement vs. > 1 debridement (N=100)

	≤ 1 debridement N=65	> 1 debridement N=35	P-value
Haemoglobin g/dl	9.4 ±1.7	9.1± 1.6	0.44
WBC count cells/cu.mm	13,650 ±5100	13,460±4780	0.78
ESR (mm/hr)	81± 28.8	85.4±21/5	0.37
HbA1c	9.84± 2.7	9.92±2.8	0.81
Dyslipidemia	26 (40.0%)	16 (45.7%)	0.55
S. Creatinine	0.97±0.38	1.04±0.37	0.36

Table-12: Compare outcomes: ≤ 1 debridement vs. > 1 debridement (N=100)

	≤ 1 debridement N=65	> 1 debridement N=35	P-value
Skin grafting	14 (21.5%)	4 (11.4%)	0.13
Hospital Stay	22.2±18.6	34.8±21.6	0.0005

DISCUSSION

In particular, the clinical profile of diabetic foot ulcer patients and potential risk factors for multiple debridements were systematically evaluated. Repeated debridements were required among diabetic foot ulcer patients who had deeper and necrotic ulcers along with hypoalbuminemia. Polymicrobial colonization was noted among the patients who required repeated debridements. It was shown that high Wagner grade of ulcer, low albumin and poly-microbial infections were risk factors for multiple debridements. Several other baseline clinical characteristics such as older age, smoking and ulcer size, limb ischemia were not found to be associated with multiple repeated debridements. Routine investigations such as glycosylated hemoglobin, white cell count, hemoglobin was not significantly different among the patients who had multiple repeated debridements. Diabetic patients, as a consequence of extended life expectancy, have many problems, including diabetic foot. Diabetes-related complications increase as the longevity of the population increases. Foot ulcer is the most common complications in the lower extremities of diabetic patients [5]. Diabetic angiopathy is reported to be the most frequent cause of morbidity and mortality in diabetic patients [6]. Macroangiopathy manifests as a diffuse multi-segmental involvement typically involving the infra-popliteal vessels, and is also associated with compromised collateral circulation. This is considered an atherosclerotic obstructive disease of large vessels, which leads to peripheral arterial disease (PAD) of the lower extremities. PAD was independently associated with a 5.5 fold increased risk for diabetic foot ulcer. Micro-angiopathy results in capillary basement membrane thickening altered nutrient exchange, and tissue hypoxia and microcirculation ischemia. Peripheral pulses such as dorsalis pedis artery and posterior tibial artery were not palpable among more than one-fifth of the patient. A metabolic panel should also be ordered for the assessment of renal function, electrolytes, acidosis, and blood glucose level. Hemoglobin A1C levels provide a barometer of glycemic control averaged over the previous 2-3 months [7]. Serum prealbumin and abumin, well known as determinants of nutritional status of the patients. Hypoalbuminemia can result from decreased albumin production secondary to protein malnutrition, defective synthesis due to hepatocyte damage, deficient intake of essential amino acids, increased loss through inadequate GI and renal function and commonly through acute and chronic inflammatory states. In this study population, mean serum albumin was 3.0 g/dl, which is less than the normal values. Interestingly, the group that required multiple debridements had significantly lower albumin (2.58 g/dl) compared to the other group [8-9]. More research is warranted to better assess the relationship of serum albumin and prealbumin levels with DFU. The majority of wounds are caused by Staphylococcus aureus, beta-hemolytic streptococciand other gram-positive cocci [10]. Although community acquired cases of resistant bacterial infections have been reported, patients who have been previously hospitalized with an open wound are more likely to develop an infection from resistant bacteria such as methicillin-

resistant S aureus (MRSA) [11]. Chronic wounds may develop a more complex assortment of bacteria, including gram-negative rods, obligate anaerobes, Pseudomonas aeruginosa, and enterococci. Diabetic foot ulcerations are colonized by pathogenic bacteria that may predispose a susceptible patient to a lower extremity infection, defined as invasion and multiplication of microorganisms in body tissues associated with tissue destruction or host inflammatory response. Once a colonized wound progresses to an infected wound, microbiological analysis permits the appropriate selection of antimicrobial therapy. In this study, polymicrobial organisms colonized diabetic foot ulcers. Among them, anaerobes such as Eschirichia coli, Klebsiella and Proteus more commonly grew on culture media than gram-positive organisms such as staphylococcus and streptococcus [12]. Around 22% of the patients among this study population did not grow any bacteria on the culture media. The patients who required multiple debridements significantly colonized with more number of organisms in the wound. Surgical management of moderate to severe diabetic foot ulcer is often required and includes aggressive incision, drainage and debridement of nonviable soft tissue and bone. Multiple debridements are often necessary to provide adequate drainage and control of infection. Multiple debridements were necessitated among 1/3rd of the study population for the management of the diabetic foot ulcer. The need for both minor (removal of a portion of foot distal to the ankle joint) and major amputations (proximal to the ankle joint) increased as the severity of infection increased. Foot infections can extend proximally into the leg through the tarsal tunnel, resulting in rapidly ascending limb and life threatening infection. Early surgical treatment of DFU may reduce the need for major amputations [13]. However, there are few limitations to this study. This study is a retrospective study. In-hospital glycemic control was not assessed and included in the study. Patients with other comorbidities such as renal, cardiac and respiratory failure were not included in the study. Ophthalmic evaluation, echocardiography, toe pressure evaluation was not evaluated routinely for all the patients and so were not included in the study. Doppler ultrasound of the arterial system was not routinely performed in all patients. The study was performed in a rural hospital where most patients were from rural area and are illiterate. Patients would benefit from foot care education [14]. Repeated debridements were commonly required among diabetic foot ulcer patients. Patients with deeper and necrotic ulcers along with low albumin levels required multiple debridements. Patients underwent multiple debridements had more bacterial colonization. Strict asepsis and proper wound handling should be performed during wound care for diabetic patients. Nutrition supplements especially protein supplementation may benefit in the already malnourished patients. Good glycemic control along with proper foot care may prevent diabetic foot ulcers, as most of the patients did not have good glycemic control at the time of admission. As these patients have polymicrobial infections, broad spectrum antibiotics covering gram positive, gram negative and anaerobic organisms should be started.

CONCLUSION

Diabetes complications such as foot ulcers are common among the elderly population and most commonly secondary to risk factors such as peripheral arterial disease and neuropathy. Most of the patients lacked glycemic control at admission. Poor glycemic control is also a risk factor for development of the ulcers. Poor glycemic control among the study population indicates lack of primary care in these rural areas. The risk factors identified among the patients who underwent multiple debridements were higher grade of Wagner diabetic foot ulcer classification, infections and poor nutrition (hypoalbuminemia). Repeated debridements were common among diabetic foot ulcer patients who had deeper and necrotic ulcers along with hypoalbuminemia. Early recognition of the ulcers and prompt management can prevent multiple debridements and prolonged hospitalization.

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