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STUDY ON MANAGEMENT OF DIABETIC FOOT ULCER IN A RURAL TRIBAL POPULATION IN A TERTIARY CARE HOSPITAL OF WESTERN MAHARASHTRA

General Medicine

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a serious complication of diabetes, particularly in rural populations, and contribute to morbidity, amputation, and healthcare costs. **Objectives:** To evaluate the risk factors, management, and complications of DFUs in patients at a tertiary care hospital in Western Maharashtra. **Methods:** A prospective study of 110 DFU patients was conducted between January 2024 and June 2025. Clinical, demographic, biochemical, and microbiological data were also collected. The patients underwent debridement, wound care, amputation, or skin grafting. The outcomes were assessed using Wagner's classification. **Results:** Of 110 patients, 62.7% were male, mean age of 63.1 years. Poor glycemic control was prevalent, with 80.9% having HbA1c >9. Right foot involvement was 52.7%. Staphylococcus aureus (23.6%) was the main pathogen, followed by Klebsiella spp. (16.4%), and Streptococcus spp.(14.5%). Treatment included debridement (57.3%), primary healing (18.2%), amputation (13.6%), and skin grafting (10.9%). Advanced Wagner grades correlated with osteomyelitis and amputation rates. **Conclusion:** DFUs are common in elderly men with uncontrolled diabetes mellitus. Debridement was the primary treatment, with amputation associated with a higher Wagner grade. Early diagnosis, glycemic control, antibiotic therapy, and surgical intervention improve outcomes. Patient education and foot care are vital to reduce the burden of DFUs.[1]

KEYWORDS

Diabetic foot ulcer, Glycemic control, Wagner classification, Debridement, Amputation, Rural population

INTRODUCTION

Diabetes mellitus is a significant systemic condition with a rising prevalence in India and globally [1] and is among the top 10 causes of death, including cardiovascular disease, respiratory disease, and cancer.[2,3] In 2019, it was estimated that 77 million people in India had diabetes, and this number is projected to exceed 134 million by 2045.[4] Currently, India ranks second in the world in terms of the number of patients with diabetes, earning it the title of the world's potential diabetes capital. Diabetes is associated with numerous complications, including microvascular, macrovascular, and metabolic complications. Diabetic foot ulcers are a common complication in individuals with diabetes, and their incidence has increased over the past few decades. Studies have reported an average annual incidence rate of 2.2% for chronic wounds.[1] These wounds have a profound impact on patient mortality, morbidity, and the overall quality of life. The causes of diabetic foot are multifaceted, and include peripheral neuropathy, peripheral vascular disease, foot deformities, poor foot care practices, diabetes duration of more than 10 years, and elevated glycated hemoglobin (HbA1c) levels. Diabetic foot ulcers can eventually result in infection, gangrene, amputation, or even death.[5] Patients with diabetic foot ulcers often face the need for amputation, with the rate being 15 times higher in patients with diabetes than in those without.nondiabetics. Limb amputation has a major impact on the individual, not only distorting the body, but also resulting in loss of productivity and increased dependence. In addition, there are major socioeconomic implications associated with foot ulcers, such as the cost of hospital admission in cases of amputation or revascularisation.

Objectives

The objective of this study was to identify the risk factors and various treatment methods, and to assess the complications associated with diabetic foot ulcers.

MATERIALAND METHODOLOGY

Study Design:- prospective observational study

No. This study included 110 patients with foot ulcers who were admitted and treated at the Vedantaa Institute of Medical Sciences between January 2024 and June 2025.

Duration Of Study:- 18 months

Inclusion Criteria:-

- All patients aged > 18 years were diagnosed with diabetic foot ulcers.

Exclusion Criteria:-

- Patients with peripheral vascular disease not arising from diabetes.
- patients with varicose veins
- Patients who were undergoing chemotherapy or were immunocompromised.

Data Collection:-

Ethical approval was obtained from the institution, and written informed consent was obtained from all patients participating in the study. The collected data included demographic information, chief complaints, history of presenting illness, medical history, personal history, family history, duration of diabetes, findings from local examinations, and blood pressure measurements. These were recorded alongside blood investigations, including blood glucose levels (fasting and postprandial), HbA1c, complete blood count, hemoglobin, total count, erythrocyte sedimentation rate, serum creatinine, blood urea, high-density lipoprotein, low-density lipoprotein, and bleeding time–clotting time. Specific investigations, including discharge from the wound or /biopsy for culture, routine urine tests, foot radiography, and Doppler studies, were conducted. Several treatments have been developed for this purpose. Based on the size, site, and progression of the ulcer, as well as the presence of infection, one of the following treatment methods was selected: debridement, amputation, conservative treatment such as dressing, or split-thickness skin grafting. The patients were subsequently monitored for post-procedural complications. Following discharge, patients were followed up at 1, 2, and 4 weeks after discharge. The collected data were analyzed and tabulated.

RESULTS

The collected data were analyzed and documented. In our study, there were 69 (62.7%) male patients and 41 (37.3%) female patients [Table 1]. The male -to -female ratio was 1.6.

Table 1:- Sex distribution

Sex	n (%)
Male	69 (62.7)
Female	41(37.3)

In our study, the maximum number of cases observed in the age group > years was 46 (41.81%), followed by 56–65 years in 35(31.81%),46–55 years, 17 (15.45%), 36–45 years in 11(10%), and 25–35 years in 1 (0.90%).

[Table 2].

Table 2:- Age Distribution	
Age	**n (%)**
25-35 Years	1(0.90)
36-45 Years	11(10)
46-55 years	17(15.45)
56- 65 Years	35 (31.81)
> 65 Years	46 (41.81)

In this study, the most common site of involvement was the right foot, observed in 58 (52.7%) patients, whereas involvement of the left foot was observed in approximately 52 (47.3%) patients [Table 3].

Table 3 :- Site of Lesion	
Site	**n (%)**
Right	58(52.7)
Left	52 (47.3)

In this study of110 patients, HbA1c was noted and found to range from 6.5 to 9 in 21 patients (19.1%), >9 in 89 (80.9%) patients, and <6.5 in 0(0%) patients[Table 4].

Table 4:- Glycated Haemoglobin Distribution	
Glycated Hemoglobin	**n (%)**
<6.5	
6.5-9	21(80.9)
>9	89 (19.1)

In our study, the most common organism found in culture was Staphylococcus aureus in 26 (23.6%) cases, followed by Klebsiella in 18 (16.4%), Streptococcus in 16 (14.5%), Escherichia coli in 14 (12.7%), Pseudomonas in 13 (11.8%), and Enterococcus in 11 (10%); no organisms were found in 12 (10.9%) cases [Table 5].

Table 5:- Incidence of different causative organisms	
Organism	**n (%)**
Staphylococcus	26 (23.6)
Klebsiella	18 (16.4)
Streptococcus	16 (14.5)
E. coli	14 (12.7)
Pseudomonas	13 (11.8)
Negative	12 (10.9)
Enterococcus	11 (10%)

In our study, 63 (57.3%) patients underwent debridement, 20 (18.2%) were managed with primary healing, 8 (7.3%) underwent major amputation, such as below-knee amputation, 7 (6.4%) underwent minor amputation, such as toe amputation and Ray's amputation, and 12 (10.9%) underwent split- skin grafting [Table 6].

Table 6:- Management of Diabetic Foot	
Treatment	n (%)
Debridement	63 (57.3)
Primary healing	20 (18.2)
Major amputation (below-knee amputation)	8(7.3)
Minor amputation • Toe amputation • Rays amputation	 5 (4.5) 2 (1.8)
Split skin grafting	12 (10.9)

In our study, the minimum age for diabetic foot ulcers was 35 years, and the maximum age was 87 years, with a mean of 63.14. Similarly, the minimum value of random blood sugar (RBS) was 125 mg/dL and the maximum was 410 mg/dL, with a mean of 308.9 mg/dL. Furthermore, the minimum HbA1c value was 7.1, and the maximum was 16, with a mean of 11.8 [Table 7].

Table 7:- Demographic And Basic Clinical Parameters For Diabetic Foot Ulcer			
Value	**Minimum**	**Maximum**	**Average**
Age	35	87	63.1
HbA1c	7.1	16	11.8
RBS	125	410	308.9

Table 8: Correlation Of Osteomyelitis And Amputation With Respect To Wagner's Classification			
Wagner'sclassification	**Foot ulcers**	**Number of patients with osteomyelitis**	**Number of patients underwent amputation**
Grade 1	29		
Grade 2	60		5
Grade 3	15	9	4
Grade 4	3	2	3
Grade 5	3	3	3

In our study, 29 (26.4%) patients had Wagner grade 1 ulcers, 60 (54.5%) had grade 2 ulcers, 15 (13.6%) had grade 3 ulcers, three (2.7%) had grade 4 ulcers, and three (2.7%) had extensive gangrene, that is, grade 5 ulcers. Furthermore, an association between osteomyelitis and amputation according to Wagner's classification was observed [Table 8].

DISCUSSION

Foot ulcers are a significant complication of diabetes mellitus.[The pathophysiology underlying the development of diabetic foot ulcers is contingent upon associated risk factors, with peripheral neuropathy-induced loss of sensation markedly increasing the likelihood of injury [7]. Such injuries may also result from ill-fitting footwear, as neuropathic patients often lack the physical symptoms that would prompt individuals without neuropathy to inspect or rest their feet. The risk of diabetic foot ulcers is seven times higher among patients with neuropathy, and altered pressure patterns further predispose these patients with foot deformities to this condition. The management of foot ulcers begins with a comprehensive patient evaluation. The primary objective is wound healing and prevention of infection spread, achieved through various interventions, such as split skin grafting, amputations, and conservative methods such as dressing. Diabetic foot ulcers are the leading cause of amputation in diabetic patients. In our study, we observed that the number of male patients was approximately 69 (62.7%), whereas that of female patients was approximately 41 (37.3%) [Table 1]. In a study conducted by Mummidi et al., 78% of affected patients were male. These findings are comparable to those of our study, which also demonstrated a male predominance, which may be due to occupational activities that make them more prone to foot ulcers.[8]

In our study, the largest proportion of cases (41.8 %) were observed in individuals aged > 65 years. The next highest group was those aged 56-65 years, comprising 31.8% of cases. Those aged 46-55 years represented 15.45% of the cases, while the 36-45 age group accounted for 10%. The fewest cases (0.9%) were found in the 25-35 age group [Table 2]. In contrast, Khan et al. found the highest number of cases in the 56–65 age group at 38.33%, followed by 46–55 years at 23.33%, over 65 years at 15%, 36–45 years at 13.33%, and the lowest in the 25–35 age group at 10%.[9] Mayfield et al. reported the highest incidence in the 56–65 years age group at 34%), with the lowest incidence in the 25–35 years age group at 2%).[10] Our findings showed that the right foot was the most frequently affected area, involved in 52.7% of the cases, whereas the left foot was affected in approximately 47.3% of the cases [Table 3]. Thus, right foot ulcers were more prevalent in our study. Regarding HbA1c levels, our study noted that none of the patients had levels < 6.5% (0%), 21(19.1%) had levels between 6.5% and 9%, and 89 (80.9%) had levels > 9% [Table 4]. Mohan et al. reported that 0% of patients had HbA1c levels below 6.5%, 34 patients (68%) with levels between 6.5 and 9, and 16 patients (32%) had levels above 9%.[11] In our study, Staphylococcus aureus was the most commonly identified organism in cultures, found in 26 (23.6%) cases, followed by Klebsiella in 18 (16.4%) cases, Streptococcus in 16 (14.5%) cases, Escherichia coli in 14 (12.7%) cases, Pseudomonas in 13 (11.8%) cases, Enterococcus in 11 (10%) cases, and no organisms were detected in 12 (10.9%) cases [Table 5]. Reiber et al.'s study of 50 patients showed the presence of S. aureus in 22%, Enterococcus in 16%, Streptococcus in 13%, E. coli in 7%, Klebsiella in 4%, and Pseudomonas in 3%.[12] In our study, 63 patients (57.3%) underwent debridement, 20 (18.2%) experienced primary healing, 15 (13.6%) underwent amputation, and 12 (10.9%) received split-thickness skin grafts [Table 6]. Prashant et al. reported that 27.5% of patients underwent debridement.[13] Reiber et al. found that 81% of patients achieved primary healing.[12] Apelqvist et al. indicated that 24% of patients underwent amputation [14], whereas RoohUlmuqim et al. showed that 48% of patients underwent amputations.[15] Khan et al. reported that 21.67% of the patients underwent skin grafting.[9]

In our study, the youngest patient with a diabetic foot ulcer was 35 years old, whereas the oldest was 87 years old, with an average age of 63.11 years. Similarly, the lowest RBS value was 125 mg/dL, the highest was 410 mg/dL, and the average was 308.9 mg/dL. The HbA1c values ranged from a minimum of 7.1 to a maximum of 16, with a mean of 11.8 [Table 7]. In a study by Mohan et al., the age range was 45–91 years, with an average age of 66.21 years. The RBS values in their study ranged from 171 to 480, with a mean of 313.64, and the HbA1c values varied from 6.99 to 17, averaging 11.32.[[11] Our study also

examined the relationship between osteomyelitis and foot amputation according to Wagner classification. Among these patients, 29 (26.4%) had grade 1 ulcers, with none showing osteomyelitis or undergoing amputation. In the Grade 2 category, 60 (54.5%) patients were observed, with no cases of osteomyelitis and five amputations. Grade 3 ulcers were observed in 15 (13.6%) patients, of whom nine had osteomyelitis and four underwent amputation. Three (2.7%) patients had grade 4 ulcers, with two cases of osteomyelitis and three cases of amputations. Lastly, three (2.7%) patients had grade 5 ulcers, all of whom had osteomyelitis and underwent amputation [Table 8]. In a study by Oyibo et al., 131 of 194 patients had grade 1 ft ulcers, with 8% undergoing amputation. Grade 2 ulcers were observed in 25 of the 194 patients, with 24% undergoing amputation. In the Grade 3 category, 36 of 194 patients were noted, with 36% undergoing amputation. Two out of 194 patients had grade 4 ulcers, with 50% undergoing amputation, and no patients had grade 5 ulcers or underwent amputation.[17]

CONCLUSION

Diabetic foot ulcers are prevalent and severe in individuals with uncontrolled diabetes, particularly older men. Factors such as inadequate glycemic management, infections caused by both Gram-positive and Gram-negative bacteria, and delayed medical attention contribute to unfavorable outcomes. Debridement was the most common treatment, whereas amputation was closely associated with higher Wagner grade and osteomyelitis. Prompt diagnosis, rigorous glycemic regulation, antibiotic therapy based on culture results, and timely surgical procedures are vital for minimizing morbidity and avoiding amputation. Preventive strategies, including patient education, regular foot care, and vascular assessment, are crucial for reducing the impact of Diabetic Foot ulcers in rural areas. Future studies should emphasize community-based screening and cost-effective advanced wound-healing methods to enhance patient outcomes and quality of life.

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