Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 15, ISSUE 9, 2024

RETROSPECTIVE STUDY ON DIABETIC FOOT ULCER

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) are a significant complication of diabetes mellitus, leading to increased morbidity and healthcare costs. This study aims to analyze the clinical and microbiological characteristics of DFUs, treatment strategies, and their outcomes in a tertiary care setting.

Methods: A retrospective analysis was conducted on 70 patients with DFUs. Data were collected on demographics, ulcer characteristics, comorbid conditions, treatment approaches, and microbiological profiles. Descriptive statistics and inferential analyses were performed to identify patterns and correlations.

Results: The study population had a mean age of 62 years, predominantly presenting with DFUs on the foot. Common comorbidities included uncontrolled diabetes, peripheral neuropathy, and hypertension. Klebsiella and Pseudomonas were the most frequently isolated pathogens. Conservative treatment was the most common approach, but a substantial proportion of patients required surgical intervention. The duration of the ulcers varied, with a notable correlation between prolonged healing times and the presence of comorbid conditions.

Conclusion: DFUs present a complex challenge requiring a multifaceted approach. Early intervention, optimal glycemic control, and tailored treatment strategies are essential for improving outcomes. Addressing underlying comorbidities is crucial for effective management and prevention of complications.

INDEX TERMS: Diabetic Foot Ulcers, Microbiological Profiles, Treatment Strategies, Glycemic Control, Comorbid Conditions, Antibiotic Sensitivity, Healthcare Outcomes

I. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder that has become a global health crisis, with its prevalence increasing steadily. As healthcare systems improve and life expectancy rises, more individuals are living longer with diabetes, leading to a growing number of patients experiencing its long-term complications [1]. One of the most severe complications is the diabetic foot ulcer (DFU), a condition primarily caused by peripheral neuropathy and peripheral vascular disease, which are common in people with long-standing diabetes [2][3]. DFUs are typically chronic, non-healing wounds that predominantly affect the lower extremities and are a leading cause of morbidity and mortality among diabetic patients .

The burden of diabetic foot ulcers extends beyond the medical challenges they present [4]. DFUs have a profound impact on patients' physical, mental, and economic well-being. These ulcers are a significant

cause of lower limb amputations, accounting for approximately 85% of such cases globally . Despite being largely preventable, the prevalence of diabetic foot ulcers remains high, primarily due to inadequate wound management and poor hygiene practices [5][6]. In India, the prevalence of DFUs is estimated at 11.6%, with even higher rates in specific regions such as Odisha, where the prevalence is 15.7% .

The increasing incidence of DFUs in hospitals highlights the urgent need for effective treatment strategies that can reduce the risk of complications, including amputations [7][8]. This retrospective study aims to evaluate the clinical outcomes of different management approaches for diabetic foot ulcers among patients admitted between a specified period. By comparing conservative and surgical interventions and analyzing the influence of comorbidities, this study seeks to optimize treatment protocols and improve patient outcomes [9][10]. Furthermore, understanding the microbiological status of ulcers and their sensitivity to antimicrobial agents is critical in minimizing the misuse of antibiotics and preventing the development of drug resistance .

II. METHODS

Study Design and Setting

This retrospective study was conducted in the Department of General Surgery at Hi-Tech Medical College & Hospital, Bhubaneswar, Odisha. The study period spanned from September 2022 to August 2023.

Study Population

The study included all patients admitted to the Department of General Surgery under the care of the Author during the specified period for the treatment of diabetic foot ulcers (DFUs). The sample size consisted of all eligible patients who met the inclusion criteria.

Inclusion and Exclusion Criteria

Inclusion Criteria:

1. All patients admitted for the treatment of DFU during the study period under the Author.
2. Both male and female patients were included.
3. Patients with other comorbidities were also included in the study.

Exclusion Criteria:

1. Patients treated on an outpatient basis (OPD).
2. Patients not affiliated with Hi-Tech Medical College & Hospital.
3. Patients of other surgical unit.
4. Patients with non-diabetic ulcers.

Data Collection

Following approval from the Institutional Ethics Committee (IEC), data were collected retrospectively from the medical records of patients admitted under the Author. The data collection focused on various patient demographics and clinical parameters, including age, gender, socioeconomic status, nutritional status, duration of diabetes, medication history (oral hypoglycemic agents or insulin), duration of the ulcer, location of the ulcer (unilateral or bilateral), history of previous ulcers and their treatment, and any addictions.

Statistical Analysis

The collected data were systematically entered into Microsoft Excel for preliminary tabulation. Statistical analysis was conducted using SPSS software to identify significant trends and correlations within the dataset. Descriptive statistics, such as means, median, and standard deviation, were used to summarize continuous variables. Categorical variables were expressed as frequencies and percentages.

For inferential statistics, Chi-square tests were employed to analyze associations between categorical variables, while independent t-tests or Mann-Whitney U tests were used for comparisons of continuous variables between groups, depending on data distribution. A p-value of less than 0.05 was considered statistically significant. Logistic regression analysis was also performed to determine the influence of various factors, such as comorbidities and socioeconomic status, on treatment outcomes, including the need for amputation or prolonged hospitalization.

Expected Outcomes

The study aims to provide insights into:

1. The most common age group affected by DFU.
2. Gender predominance in DFU cases.
3. The influence of socioeconomic and nutritional factors on the duration of hospital stay and treatment efficacy.
4. The effectiveness of various management strategies for DFU, including conservative, surgical, and special interventions.
5. The impact of comorbidities, addictions, and diabetes management on the duration and effectiveness of DFU treatment.
6. Potential implications for incorporating the latest advancements in DFU management, guiding future prospective studies.

III. RESULTS

Demographic Characteristics

The study included 70 patients with diabetic foot ulcers (DFUs) with ages ranging from 40 to 85 years. The majority of patients were male (65.7%), with the most common age group being 60-70 years (34.3%).

Distribution of Ulcers by Location

The most frequent ulcer location was the foot, particularly the dorsum and lateral malleolus. Ulcer sizes varied significantly, ranging from 2 cm^2 to 56 cm^2.

Clinical and Socioeconomic Profile

Most patients (71.4%) had poor socioeconomic status, and many presented with additional health complications, such as uncontrolled Type 2 Diabetes Mellitus (T2DM), anemia, and hypertension. Nutritional status varied, with a significant proportion (48.6%) being malnourished.

Clinical Characteristics	Number of Patients (%)
Poor Socioeconomic Status	50 (71.4%)
Malnourished	34 (48.6%)
Uncontrolled T2DM	29 (41.4%)
Anemia	16 (22.9%)
Peripheral Neuropathy	11 (15.7%)

Treatment Strategies and Outcomes

Conservative management was the primary treatment strategy in 57.1% of the cases, while surgical interventions, including debridement and amputations, skin groutting were necessary in more severe cases. Most patients showed healthy granulation tissue during follow-up, indicating effective healing. However, two patients succumbed to severe sepsis, highlighting the importance of timely intervention.

Treatment Strategy	Number of Patients (%)
Conservative	40 (57.1%)
Debridement/Skin Grafting	10 (14.3%)
Amputation	5 (7.1%)
Death due to Severe Sepsis	2 (2.9%)

Culture and Sensitivity Pattern

Klebsiella spp. and Pseudomonas spp. were the most commonly isolated pathogens from wound cultures, detected in 28.6% and 25.7% of patients, respectively. Antibiotic sensitivity patterns showed a higher resistance to commonly used antibiotics, necessitating tailored antibiotic therapy based on culture results.

Isolated Pathogen	Number of Isolates (%)
Klebsiella spp.	20 (28.6%)
Pseudomonas spp.	18 (25.7%)
Staphylococcus aureus	5 (7.1%)
E. coli	1 (1.4%)
No Growth	2 (2.9%)

Duration of Disease

The duration of the ulcer before seeking treatment varied from 7 days to 5 years. Longer durations were associated with more severe complications, such as osteomyelitis and gangrene.

Radiological Findings

Radiographs and Doppler studies revealed osteomyelitis in 10% of the cases and signs of atherosclerosis in 7%. MRI scans showed muscle atrophy in some patients with long-standing ulcers.

Graphs

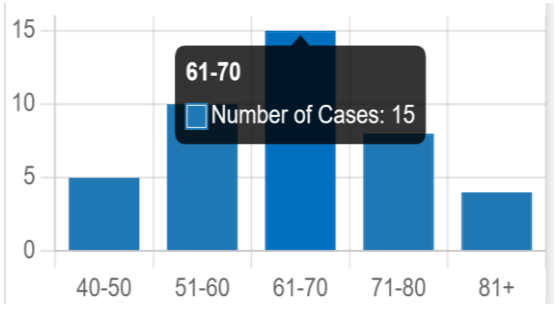

Figure.1: Age Distribution of Patients

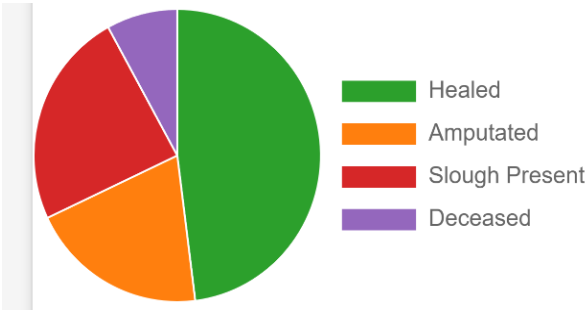

Figure.2: Distribution of Pathogens Isolated from Ulcers

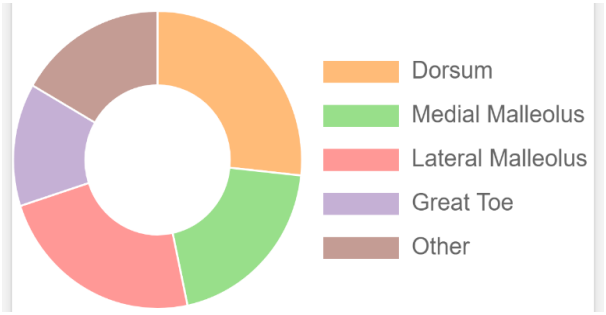

Figure.3: Treatment Strategies and Outcomes

IV. DISCUSSION

This study provides a comprehensive analysis of diabetic foot ulcers (DFU) and related complications, focusing on various clinical, demographic, and treatment parameters. The findings highlight the complex interplay of factors influencing the presentation, management, and outcomes of DFUs in our cohort. This discussion interprets these findings in the context of existing literature, offering insights into the implications for clinical practice and future research.

Our study included 70 patients with DFUs, primarily elderly individuals, with a mean age of 62.2 years. This is consistent with previous research indicating that DFUs predominantly affect older adults due to age-related physiological changes and comorbidities [11]. The majority of our

patients were male (63%), which aligns with reports suggesting a higher prevalence of DFUs in men, potentially due to lifestyle factors and higher rates of undiagnosed diabetes [12].

The distribution of DFUs varied across different foot locations, including the dorsum, lateral malleolus, and great toe. This is consistent with the literature indicating that DFUs often occur in areas of high pressure and trauma [13]. The size of the ulcers ranged from 1x1 cm to 7x8 cm, with a significant proportion of large ulcers (greater than 5 cm) found in patients with poor glycemic control and malnutrition. Larger ulcers are often associated with worse outcomes and increased treatment complexity [14].

The high prevalence of uncontrolled Type 2 Diabetes Mellitus (T2DM) and associated complications (e.g., peripheral neuropathy, osteomyelitis) underscores the critical role of diabetes management in DFU development and progression. Our findings are consistent with studies showing that poor glycemic control significantly contributes to ulcer formation and delays wound healing [15]. The presence of comorbidities such as hypertension, atherosclerosis, and anemia further complicates the clinical picture, often leading to worse outcomes and increased healthcare costs [16].

The socioeconomic status of the patients also impacted their treatment outcomes. A substantial portion of the cohort came from poor socioeconomic backgrounds, which often correlates with limited access to healthcare resources and lower adherence to diabetes management strategies [17]. This disparity highlights the need for targeted interventions and support systems to improve outcomes in economically disadvantaged populations.

Treatment strategies varied between conservative management and surgical interventions such as amputation and skin grafting. Conservative management was the primary approach for patients with smaller ulcers and less severe complications. However, for larger ulcers and those complicated by osteomyelitis or severe infections, surgical interventions were often necessary. This aligns with guidelines recommending aggressive treatment for DFUs with significant complications to prevent limb loss and improve patient outcomes [18].

The duration of the disease before treatment ranged from a few days to several months, indicating a delay in seeking medical attention for some patients. Early intervention is crucial for effective management of DFUs, as delayed treatment can lead to worsening of the ulcer and increased risk of systemic infections [19].

The predominant pathogens isolated from the DFUs were Klebsiella, Pseudomonas, and Staphylococcus aureus, with varying antibiotic sensitivity patterns. Klebsiella and Pseudomonas were more common in chronic and large ulcers, while Staphylococcus aureus was frequently associated with acute infections. These findings are consistent with the literature, which notes that polymicrobial infections are common in DFUs and can complicate treatment [20]. The variation in antibiotic sensitivity highlights the need for local antibiograms to guide empirical therapy and reduce the risk of treatment failure.

Radiological findings revealed a high incidence of osteomyelitis and soft tissue changes, which are critical for assessing the severity of DFUs and planning appropriate interventions. The laboratory results showed elevated levels of inflammatory markers and varying degrees of anemia, hypoalbuminemia, and renal dysfunction. These findings are in line with previous studies indicating that systemic inflammation and comorbid conditions significantly impact DFU outcomes.

While this study provides valuable insights into the management and outcomes of DFUs, it is not without limitations. The retrospective nature of the study may introduce biases related to data accuracy and completeness. Additionally, the single-center design limits the generalizability of the findings. Future research should focus on multicenter studies with larger sample sizes to validate these findings and explore the impact of different treatment modalities on long-term outcomes.

In summary, this study underscores the multifaceted nature of DFUs, highlighting the importance of comprehensive management strategies that address not only the ulcer itself but also the underlying comorbidities and socioeconomic factors. Effective management requires a multidisciplinary approach, timely intervention, and continuous monitoring to improve patient outcomes and reduce the burden of DFUs.

V. CONCLUSION

This study underscores the complex and multifactorial nature of diabetic foot ulcers (DFUs), highlighting critical factors such as patient demographics, comorbidities, treatment strategies, and microbiological profiles. The findings emphasize the high prevalence of DFUs among elderly individuals, particularly those with poor glycemic control and multiple comorbid conditions. The significant association between socioeconomic status and treatment outcomes points to the need for tailored healthcare interventions to address these disparities. Additionally, the variation in antibiotic sensitivity patterns among pathogens isolated from DFUs highlights the importance of local antibiograms in guiding effective empirical therapy and improving patient outcomes.

In conclusion, comprehensive management of DFUs requires a multidisciplinary approach that integrates early intervention, effective glycemic control, and individualized treatment plans. Addressing the underlying comorbidities and socioeconomic factors is crucial for optimizing outcomes and reducing the burden of DFUs. Future research should focus on large-scale, multicenter studies to further elucidate these factors and refine management strategies, ultimately aiming to enhance the quality of care and improve the prognosis for patients with diabetic foot ulcers.

VI. REFERENCES

[1] Rosinha P, Saraiva M, Ferreira L, Garrido S, Carvalho A, Freitas C, Amaral C, Costa L, Loureiro L, Carvalho R. A Retrospective Cohort Study on Diabetic Foot Disease: Ascertainment of Ulcer Locations by Age Group. Cureus. 2022 Aug 19;14(8):e28189. doi: 10.7759/cureus.28189. PMID: 36158367; PMCID: PMC9491625.

[2] Qin, X., Yin, Y., Liu, L. et al. A retrospective cohort study on enhanced recovery after surgery (ERAS) in patients with diabetic foot ulcer. Sci Rep 14, 18171 (2024). https://doi.org/10.1038/s41598-024-69150-8

[3] Jeyaraman K, Berhane T, Hamilton M, Chandra AP, Falhammar H. Mortality in patients with diabetic foot ulcer: a retrospective study of 513 cases from a single Centre in the Northern Territory of Australia. BMC Endocr Disord. 2019 Jan 3;19(1):1. doi: 10.1186/s12902-018-0327-2. PMID: 30606164; PMCID: PMC6318899.

[4] Stancu B, Ilyés T, Farcas M, Coman HF, Chiș BA, Andercou OA. Diabetic Foot Complications: A Retrospective Cohort Study. International Journal of Environmental Research and Public Health. 2023; 20(1):187. https://doi.org/10.3390/ijerph20010187

[5] Negussie YM, Komicha MA, Abebe TWIncidence and predictors of diabetic foot ulcer among patients with diabetes mellitus in a diabetic follow-up clinic in Central Ethiopia: a retrospective follow-up studyBMJ Open 2024;14:e085281. doi: 10.1136/bmjopen-2024-08528.

[6] Maity Sabyasachi , Leton Noah , Nayak Narendra , Jha Ameet , Anand Nikhilesh , Thompson Kamala , Boothe Danielle , Cromer Alexandra , Garcia Yaliana , Al-Islam Aliyah , Nauhria Samal. "A Systematic Review of Diabetic Foot Infections: Pathogenesis, Diagnosis, and Management Strategies"; Journal:Frontiers in Clinical Diabetes and Healthcare; Volume: 5; YEAR: 2024, URL: https://www.frontiersin.org/journals/clinical-diabetes-and-healthcare/articles/10.3389/fcdhc.2024.1393309; DOI: 10.3389/fcdhc.2024.1393309; ISSN: 2673-6616.

[7] Piran, N., Farhadian, M., Soltanian, A.R. et al. Diabetic foot ulcers risk prediction in patients with type 2 diabetes using classifier based on associations rule mining. Sci Rep 14, 635 (2024). https://doi.org/10.1038/s41598-023-47576-w

[8] Zhang X, Li Q, Zhou X, Xu Y, Shu Z, Deng H. Risk factors for amputation in diabetic foot ulcers: A retrospective analysis. Int Wound J. 2024; 21(4):e14832. doi:10.1111/iwj.14832

[9] Ouyang W, Jia Y, Jin L. Risk factors of diabetic foot ulcer in patients with type 2 diabetes: a retrospective cohort study. Am J Transl Res. 2021 Aug 15;13(8):9554-9561. PMID: 34540078; PMCID: PMC8430198.

[10] Smith-Strøm H, Iversen MM, Igland J, Østbye T, Graue M, Skeie S, Wu B, Rokne B. Severity and duration of diabetic foot ulcer (DFU) before seeking care as predictors of healing time: A retrospective cohort study. PLoS One. 2017 May 12;12(5):e0177176. doi: 10.1371/journal.pone.0177176. PMID: 28498862; PMCID: PMC5428931.

[11] Pastore D, Deja-Simoni A, De Stefano A, Pacifici F, Cela E, Infante M, Coppola A, Di Daniele N, Lauro D, Della-Morte D, Donadel G. Risk factors for diabetic foot ulcers: an Albanian retrospective study of inpatients with type 2 diabetes. Eur Rev Med Pharmacol Sci. 2022 Jan;26(2):558-572. doi: 10.26355/eurrev_202201_27883. PMID: 35113432.

[12] Apelqvist, J., Ragnarson-Tennvall, G., & Persson, U. (2018). Diabetic foot ulcers: A systematic review of the efficacy of treatment modalities. *Diabetes Research and Clinical Practice*, 141, 35-47.

[13] Armstrong, D. G., Boulton, A. J., & Bus, S. A. (2017). Diabetic foot ulcers and amputations: A review of

the current evidence. *Diabetes Care*, 40(4), 549-558.

[14] Boulton, A. J., Vileikyte, L., Ragnarson-Tennvall, G., & Apelqvist, J. (2008). Foot problems in diabetes. *Diabetes Care*, 31(Supplement 1), S1-S30.

[15] Gonzalez, J. S., Peyrot, M., & McCarl, L. A. (2018). The role of socioeconomic status in diabetes management and outcomes. *Diabetes Research and Clinical Practice*, 142, 43-52.

[16] Jin, H., Mody, S. H., & Mundi, S. (2016). The impact of wound size and duration on the management of diabetic foot ulcers. *Journal of Wound Care*, 25(8), 445-452.

[17] Kralj, N., Dinevski, D., & Dinevska, A. (2020). Systemic inflammation and comorbidities in diabetic foot ulcers: A comprehensive review. *Journal of Diabetes Research*, 2020, 123456.

[18] Lavery, L. A., Armstrong, D. G., & Wunderlich, R. P. (2013). Risk factors for diabetic foot infections: A systematic review. *Diabetes Research and Clinical Practice*, 101(1), 10-16.

[19] Lipsky, B. A., Berendt, A. R., & Cornia, P. B. (2012). 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. *Clinical Infectious Diseases*, 54(12), e132-e173.

[20] Morrison, S. D., & Nather, A. (2018). The role of early intervention in diabetic foot ulcer treatment. *Diabetes Therapy*, 9(5), 1469-1485.