

Impact of multidisciplinary management via special clinic for the outcome of diabetic foot disease: A prospective observational study

Satya P. Meena¹, Mayank Badkur¹, Mahendra Lodha¹, Mahaveer S. Rodha¹,
Ramkaran Chaudhary¹, Naveen Sharma¹, Prakash C. Kala², Ravi Gaur³,
Sumit Bishnoi¹

¹Department of General Surgery, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India, ²Department of Burn and Plastic Surgery, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India, ³Department of Physical Medicine and Rehabilitation, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India

ABSTRACT

Introduction: Diabetic foot is a common complication of diabetes mellitus, affecting approximately 15–20% of individuals with diabetes. It is a comorbid condition that significantly impacts the routine life of patients. This study aimed to assess multidisciplinary management strategies and their impact on the outcomes of patients with diabetic foot. **Methods:** A prospective observational study was conducted on 56 patients with diabetic foot. Outcome measures included the type of surgery, frequency of surgery, morbidity, mortality, patient satisfaction, return to work, and the number of patients using prostheses. **Results:** The majority of the patients (87%) received surgical treatment. The most common type of surgery performed was debridement (55%), followed by minor amputations (toes amputation/forefoot amputation) (28%) and major amputations (below-knee (B/K) or above-knee (A/K)) (15%). More than 70% of patients had multiple surgeries. The mortality rate was low (7%), and 71% of surviving patients were satisfied with their treatment. Sixty-seven percent of patients had an early return to work. The number of patients using prostheses was also high (73% of major amputation cases). **Conclusion:** Multidisciplinary management is the most effective approach for diabetic foot patients. These patients may experience less morbidity and an early return to work. A specialized care clinic for diabetic foot patients is essential to prevent treatment failure, loss of follow-up records, permanent limb loss, and economic burdens on society.

Keywords: Amputation, diabetic foot, morbidity, mortality, multidisciplinary management

Introduction

Diabetic foot infections are a common complication of diabetes mellitus, affecting approximately 15–20% of individuals with

diabetes.^[1] It is characterized by a combination of neuropathy, peripheral vascular disease, and infection. The cost of treating diabetic foot is high, and the condition is associated with significant morbidity and mortality.^[2] Thus, it is important to identify effective management strategies to reduce the burden of the disease. Multidisciplinary management of diabetic foot has been recommended as an effective approach to improving outcomes.^[3] This type of management has been shown to reduce the risk of amputation and improve patient satisfaction.

Address for correspondence: Dr. Satya P. Meena,
Department of General Surgery, All India Institute of Medical
Sciences, Jodhpur, Rajasthan, India.
E-mail: drsatyaprakash04@gmail.com

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Methods

Study design, setting, and size

Institutional Ethics Committee, All India Institute of Medical Sciences Jodhpur issued research approval on 15/09/2020 (AIIMS/IEC/2020/3268). This prospective observational study was conducted in a tertiary care hospital in India from 2021 to 2023. A total of 56 patients with diabetic foot were included.

Aim

The purpose of this study was to evaluate the impact of multidisciplinary management strategies in a special diabetic foot clinic on the outcomes of patients with diabetic foot infections.

Objectives

The primary objective was to evaluate the outcomes of diabetic foot ulcers (DFUs) in terms of healing, complications, and permanent disability. Secondary objectives were to streamline the management of DFUs with a multidisciplinary approach to improve the quality of care for DFU patients.

Patient selection criteria

The study included all diabetic patients aged between 18 and 80 years with foot infections. Patients with amputations above the ankle joint, established gangrene above the ankle joint, vascular surgery for peripheral arterial disease, chemo-radiotherapy for malignancy, paralysis, psychiatric conditions, or those who did not provide consent were excluded.

Procedure

All patients were admitted to the Department of General Surgery from the outpatient or emergency department. The study included 56 diabetic foot patients managed through a multidisciplinary approach at a special clinic. Patients underwent various surgical procedures, and a comprehensive care plan was provided. Patients were followed up and monitored for progress and postoperative outcomes.

Statistical analysis

Demographic details, operative data, and follow-up records were maintained in an Excel sheet. Descriptive statistics were used to summarize the data. The Statistical Package for Social Sciences (SPSS) version (23.0) was used to examine the data once they were entered into Excel. Descriptive statistics such as mean, standard deviation for continuous variables, and frequency, along with percentages of categorical variables, were calculated.

Results

The majority of patients were between 35 and 70 years old, with three times as many male patients as female patients. Coronary artery disease with hypertension (23%) was the most common comorbidity among the study patients. Additionally, the most common complication was peripheral vascular disease (28%),

followed by peripheral neuropathy (21%) in DFUs [Table 1]. Blood sugar levels and HbA1c (glycated hemoglobin) levels were monitored throughout the study to assess glycemic control among diabetic foot patients. The average blood sugar level was 185.63 mg/dl, with the majority of patients achieving adequate glycemic control (156 mg/dl) within 6 months of follow-up. Similarly, the mean HbA1c level was 9.14 at the time of admission and was found to be 6.6 after 6 months, indicating overall good long-term glycemic control among the study population.

Upon presentation to the special clinic, diabetic foot patients exhibited various clinical signs including foot ulcers (42%), signs of infection such as erythema and purulent discharge (5%), gangrenous changes (53%), and sensory deficits suggestive of peripheral neuropathy (21%) [Table 2 and Figure 1].

Patients in the study underwent various surgical interventions depending on the severity and extent of their diabetic foot pathology. Options of surgery included debridement of necrotic tissue, incision, and drainage of abscesses, and in severe cases, minor (59%) or major amputations (22%) such as toe or below-knee amputations. The level of amputation varied depending on the extent of tissue involvement and vascular compromise. Almost all patients had 2–5 debridements with or without amputations [Table 3].

The overall morbidity and mortality rates were 80% and 7% in the study. The most common complications were infection followed

Table 1: Demography and clinical status of study patients at the time of presentation

Criteria	Study patients
Age, Years (Mean)	57.48±1.23
Male	43 (77%)
Female	13 (23%)
Patients associated with PVD	16 (28%)
Patients associated with peripheral neuropathy	12 (21%)
Patients associated with CAD/cardiac disease with hypertension	13 (23%)
Patients associated with immuno-compromised condition (retro-positive)	1 (1.7%)
Duration of diabetic status, Years (Median, range)	12 (4–20)
Duration of ulcer, Months (Median, range)	4 (1–15)
HbA1C (Mean, SD)	9.14±2.50
Hb (Mean, SD) Gm%	10.75±2.09
TLC (Mean, SD), 10 ³	20.84±15.84
RBS (Mean, SD)	185.63±62.27

Table 2: Wagner grading of ulcer among the study patients at the time of presentation

Grade	No.	Percentage
Mild Cellulitis	3	5.3
Superficial ulcer	8	14.3
Deep ulcer involving tendon and capsule	5	9
Local abscess or osteomyelitis	10	17.8
Localized gangrene	18	32
Foot gangrene	12	21.4



Figure 1: Image showing diabetic foot ulcers of the patients who had definitive surgery as (a) Toe amputation (b and c) B/K amputation (d) Debridement only

Table 3: Definitive surgical procedure performed among the study patients during hospital stay	
Final surgical procedure performed	No % of patients
Only Debridement	11 (19.6%)
Great Toe amputation	15 (27%)
Two or More than two toes amputation	14 (25%)
Forefoot amputation	4 (7%)
Below-knee amputation	7 (13%)
Knee disarticulation	1 (1.7%)
Above-knee amputation	4 (7%)
Vascular intervention	2 (3.5%)

by wound healing problems and pain. The most common cause of death was cardiovascular disease.

More than 70% of patients were satisfied with the management in the special clinic. The rest were either neutral or unsatisfied due to long hospital stays, multiple surgeries, and delayed wound healing due to infections. The majority of patients (73%) had prostheses and 67% returned to work after the healing of wounds within one year of follow-up [Table 4].

Discussion

Diabetes is a chronic metabolic disorder characterized by hyperglycemia, which is caused by the body’s inability to produce or utilize insulin.^[4] Diabetic foot is one of the most common and severe complications of diabetes, associated with high morbidity, mortality, and economic burden.^[5] The management of diabetic foot requires a multidisciplinary approach involving various healthcare professionals.^[6] Proper assessment of diabetic patients for high-risk factors must be conducted every three months. Early signs of skin breakdown, redness, and swelling, along with high HbA1c levels, require immediate medical attention.^[7] Patients with DFUs have a higher incidence of lower limb amputations

due to peripheral neuropathy.^[8] Negligence or inadequate treatment can lead to foot ulcers and their complications.^[9]

People in middle or upper-middle economic status are more educated and aware of diabetes complications, while those in lower economic status are often neglected due to poverty and lack of awareness.^[10] Developing countries like India should implement foot care programs through various media channels to educate diabetic patients.^[11] Patients at high risk of complications should receive counseling for regular follow-up and daily foot assessments.^[12]

Patients with complicated diabetic foot require daily dressing followed by negative pressure wound therapy (NPWT) for early healing. Evidence for the benefits of NPWT in diabetic foot patients is limited.^[13,14] Growth factors from platelets, macrophages, and endothelium, as well as hyperbaric oxygen therapy, also show low levels of evidence for managing diabetic foot.^[15,16] Studies on ozone therapy and phototherapy have shown uncertain benefits over conventional therapy.^[17,18] Vitamin supplements may aid in healing and reduce mortality.^[19]

A multidisciplinary approach and disease awareness are key to preventing complications in diabetic patients. Specialized diabetic foot clinics with various specialties can provide comprehensive care.^[6,20,21] A physician or endocrinologist should be a team leader to follow these patients in this clinic.^[22] Teleconsultation and psycho-social counseling can aid in monitoring and reducing morbidity. Psychological strategies for stress reduction can improve wound healing and glycemic control.^[23]

Phyo *et al.*^[24] study has shown 38% mortality and 50% healing rate in a year for diabetic foot patients; however, in this study, 7% patients had mortality and 85% patients had complete healing of wound in 6 months of special care. Palmer *et al.*^[25] showed a higher

Table 4: The outcome of the diabetic patients including one year follow-up

Outcome	Results
Hospital stay, Days (Median, Range)	12 (3–57)
Frequency of admission (Mean, SD)	1.64±0.86
Frequency of surgery under GA/SA (Mean, SD)	2.43±1.48
HbA1C (Mean, SD)	6.66±0.88
RBS (Mean, SD)	156.73±32.81
Healing rate (No. of patients, %)	
Not healed	3 (5.4%) All expired
Healing stage (Granulating)	5 (9%)
Healed	48 (85.6%) One expired
Mortality (No. of patients, %)	4 (7.14%)
Prosthesis applied (No. of patients, %)	41 (73.21%)
Return to work (No. of patients, %)	38 (67%)
Satisfaction regarding multidisciplinary management in survived patients (Likert's scale) (No. of patients, %)	
1. Very satisfied	28 (54%)
2. Satisfied	9 (17%)
3. Neutral for opinion	10 (19%)
4. Unsatisfied	5 (9.6%)
5. Very unsatisfied	0

rate of non-employment (more than 50%) among patients with diabetic foot. They incur high expenses for long-term treatment, such as frequent admissions, use of offloading devices or casts, and procedure fees. Hence, these people require economic and psychological rehabilitation. Oyewole *et al.*^[26] also has shown 31–60% functional inactivity due to comorbidities associated with diabetes, such as renal, cardiac, and neurological symptoms. They had functional and psychological dependency after 50 years of age. In the study, 67% of patients had returned to work for their job and other people had psychological distress, lack of confidence, or isolation from the active earning society. A specialized clinic may provide comprehensive care under a single umbrella for the screening and definitive care of foot infections.

Conclusion

Multidisciplinary management strategies have a positive impact on diabetic foot outcomes. A well-established diabetic foot clinic can improve patient satisfaction, prosthetic use, and reduce mortality. Palliative care can decrease morbidity, treatment costs, and social burden.

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Key message

Multidisciplinary management in a special clinic is the most effective approach for diabetic foot patients.

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Conflicts of interest

There are no conflicts of interest.

References

1. Lim JZM, Ng NSL, Thomas C. Prevention and treatment of diabetic foot ulcers. *J R Soc Med* 2017;110:104-9.
2. Reardon R, Simring D, Kim B, Mortensen J, Williams D, Leslie A. The diabetic foot ulcer. *Aust J Gen Pract* 2020;49:250-5.
3. van Baal JG, Aan de Stegge WB, Schaper NC. [A multidisciplinary approach in diabetic foot disease is mandatory]. *Ned Tijdschr Geneesk* 2017;161:D1755.
4. Das SK, Roy P, Singh P, Diwakar M, Singh V, Maurya A, *et al.* Diabetic foot ulcer identification: A review. *Diagn Basel Switz* 2023;13:1998. doi: 10.3390/diagnostics13121998.
5. Diabetic foot infections: A comprehensive overview. Available from: <https://www.europeanreview.org/article/17471>. [Last accessed on 2023 Aug 29].
6. Wang A, Lv G, Cheng X, Ma X, Wang W, Gui J, *et al.* Guidelines on multidisciplinary approaches for the prevention and management of diabetic foot disease (2020 edition). *Burns Trauma* 2020;8:tkaa017. doi: 10.1093/burnst/tkaa017.
7. Chin YF, Yeh JT, Yu HY, Weng LC. Knowledge of the warning signs of foot ulcer deterioration among patients with diabetes. *J Nurs Res JNR* 2018;26:420-6.
8. Akila M, Ramesh RS, Kumari MJ. Assessment of diabetic foot risk among diabetic patients in a tertiary care hospital, South India. *J Educ Health Promot* 2021;10:14.
9. Ramachandran V, Mohanasundaram T, Karunakaran D, Gunasekaran M, Tiwari R. Physiological and pathophysiological aspects of diabetic foot ulcer and its treatment strategies. *Curr Diabetes Rev* 2023;19:e031122210617. doi: 10.2174/1573399819666221103141715.
10. B G S, V U, Shivaram JM, Belehalli P, M A S, H C C, *et al.* Diabetic foot assessment and care: Barriers and facilitators in a cross-sectional study in Bangalore, India. *Int J Environ Res Public Health* 2023;20:5929. doi: 10.3390/ijerph20115929.
11. Shaki O, Gupta GK, Rai SK, Gupta TP, Kumar RV, Upreti V, *et al.* Awareness regarding foot self-care practices among diabetic patients in Northeast part of India. Can primary care physician make a difference? A hospital based cross-sectional study. *J Fam Med Prim Care* 2022;11:1834-41.
12. Verma M, Sharma N, Rashi, Arora V, Bashar MA, Nath B, *et al.* Diabetic foot care knowledge and practices in rural north India: Insights for preventive podiatry. *J Assoc Physicians India* 2021;69:30-4.
13. Maranna H, Lal P, Mishra A, Bains L, Sawant G, Bhatia R, *et al.* Negative pressure wound therapy in grade 1 and 2 diabetic foot ulcers: A randomized controlled study. *Diabetes Metab Syndr* 2021;15:365-71.
14. Liu Z, Dumville JC, Hinchliffe RJ, Cullum N, Game F, Stubbs N, *et al.* Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. *Cochrane Database Syst Rev* 2018;10:CD010318. doi: 10.1002/14651858.CD010318.pub3.
15. Sharma R, Sharma SK, Mudgal SK, Jelly P, Thakur K. Efficacy

- of hyperbaric oxygen therapy for diabetic foot ulcer, a systematic review and meta-analysis of controlled clinical trials. *Sci Rep* 2021;11:2189.
16. Martí-Carvajal AJ, Gluud C, Nicola S, Simancas-Racines D, Reveiz L, Oliva P, *et al.* Growth factors for treating diabetic foot ulcers. *Cochrane Database Syst Rev* 2015;2015:CD008548. doi: 10.1002/14651858.CD008548.pub2.
 17. Liu J, Zhang P, Tian J, Li L, Li J, Tian JH, *et al.* Ozone therapy for treating foot ulcers in people with diabetes. *Cochrane Database Syst Rev* 2015;2015:CD008474. doi: 10.1002/14651858.CD008474.pub2.
 18. Wang HT, Yuan JQ, Zhang B, Dong ML, Mao C, Hu D. Phototherapy for treating foot ulcers in people with diabetes. *Cochrane Database Syst Rev* 2017;6:CD011979. doi: 10.1002/14651858.CD011979.pub2.
 19. Tang W, Chen L, Ma W, Liu G, Chen D, Wang C, *et al.* Association of vitamin D status with all-cause mortality and outcomes among Chinese individuals with diabetic foot ulcers. *J Diabetes Investig* 2023;14:122-31.
 20. Everett E, Mathioudakis N. Update on management of diabetic foot ulcers. *Ann N Y Acad Sci* 2018;1411:153-65.
 21. Andrews KL, Houdek MT, Kiemele LJ. Wound management of chronic diabetic foot ulcers: From the basics to regenerative medicine. *Prosthet Orthot Int* 2015;39:29-39.
 22. Nigi L, Fondelli C, de Donato G, Palasciano G, Setacci C, Dotta F. Fighting diabetic foot ulcers-The diabetologist: A king maker of the fight. *Semin Vasc Surg* 2018;31:49-55.
 23. McGloin H, Devane D, McIntosh CD, Winkley K, Gethin G. Psychological interventions for treating foot ulcers, and preventing their recurrence, in people with diabetes. *Cochrane Database Syst Rev* 2021;2:CD012835. doi: 10.1002/14651858.CD012835.pub2.
 24. Phyo N, Tang W, Kavarthapu V. Medium-term outcomes of multi-disciplinary surgical management of non-ischemic diabetic heel ulcers. *J Clin Orthop Trauma* 2021;17:30-6.
 25. Palmer KNB, Crocker RM, Marrero DG, Tan TW. A vicious cycle: Employment challenges associated with diabetes foot ulcers in an economically marginalized Southwest US sample. *Front Clin Diabetes Healthc* 2023;4:1027578. doi: 10.3389/fcdhc.2023.1027578.
 26. Oyewole OO, Ale AO, Ogunlana MO, Gurayah T. Burden of disability in type 2 diabetes mellitus and the moderating effects of physical activity. *World J Clin Cases* 2023;11:3128-39.