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A COMPARATIVE ANALYSIS OF VACUUM ASSISTED CLOSURE THERAPY AND CONVENTIONAL DRESSINGS: OUTCOMES IN CHRONIC DIABETIC FOOT ULCERS AMONG INDIAN PATIENTS

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ABSTRACT

Background: Diabetic foot ulcers (DFUs) represent a major complication of diabetes mellitus and are a leading cause of morbidity, prolonged hospitalization, and non-traumatic lower limb amputations worldwide. In India, the burden of diabetic foot disease is substantial due to increasing diabetes prevalence and delayed healthcare access. Effective wound management is crucial to promote healing, prevent infection, and reduce amputation rates. Conventional dressing methods have been widely used; however, vacuum assisted closure (VAC) therapy has emerged as an advanced wound care modality that enhances granulation tissue formation, reduces edema, and improves local perfusion. Despite growing use, comparative evidence in the Indian clinical setting remains limited. **Objectives:** To compare the effectiveness of vacuum assisted closure therapy with conventional dressing methods in the management of chronic diabetic foot ulcers and to evaluate outcomes in terms of wound healing, duration of hospital stay, infection control, and need for surgical intervention.

Materials and Methods: This prospective comparative study was conducted in a tertiary care hospital in India over a period of 12 months from January 2025 to December 2025. A total of 130 patients with chronic diabetic foot ulcers were enrolled and equally allocated into two groups: VAC therapy group (n=65) and conventional dressing group (n=65). Patients were followed up throughout hospitalization and wound progression was assessed using standardized clinical parameters. Outcome measures included rate of wound size reduction, time to development of healthy granulation tissue, duration of hospital stay, incidence of infection, and need for surgical procedures including debridement and amputation.

Results: Patients treated with vacuum assisted closure therapy demonstrated significantly faster wound healing compared to those receiving conventional dressings. The VAC group showed earlier formation of healthy granulation tissue and greater reduction in wound size over time. Infection rates were lower in the VAC group, with better control of wound exudate and bacterial load. Additionally, patients in the VAC group had a shorter duration of hospital stay and reduced requirement for repeated surgical debridement. The incidence of major amputations was also lower in patients managed with VAC therapy. Overall, VAC therapy was associated with improved clinical outcomes and more efficient wound management.

Conclusions: Vacuum assisted closure therapy is a superior modality compared to conventional dressings in the management of chronic diabetic foot ulcers. It promotes faster wound healing, reduces infection rates, shortens hospital stay, and decreases the need for major surgical interventions. Incorporating VAC therapy into routine clinical practice in tertiary care settings may significantly improve outcomes in patients with diabetic foot ulcers.

Keywords: Diabetic foot ulcer; Vacuum assisted closure; Negative pressure wound therapy; Conventional dressing; Wound healing; Infection control; Amputation; India.

INTRODUCTION

Diabetic foot ulcers (DFUs) are among the most serious and debilitating complications of diabetes mellitus, contributing significantly to patient morbidity, reduced quality of life, and increased healthcare burden.[1] Globally, the lifetime risk of developing a diabetic foot ulcer in patients with diabetes is substantial, and these ulcers frequently precede lower limb amputations. In India, the rising prevalence of diabetes, coupled with delayed presentation, poor glycemic control, and limited awareness regarding foot care, has led to an increasing incidence of chronic and complicated diabetic foot ulcers.[2]

The pathogenesis of diabetic foot ulcers is multifactorial, involving peripheral neuropathy, peripheral arterial disease, immunopathy, and repetitive trauma. These factors collectively impair wound healing and predispose to infection.[3] Chronicity of these ulcers often results in prolonged hospital stay, repeated surgical interventions, and increased risk of both minor and major amputations. Therefore, effective and timely wound management plays a pivotal role in improving clinical outcomes.[4]

Conventional wound dressing methods, including saline dressings, antiseptic applications, and gauze-based techniques, have been the cornerstone of diabetic foot ulcer management for decades. While these methods are cost-effective and widely available, they often require frequent changes, may not adequately control wound exudate, and can be associated with delayed healing and higher infection rates in complex wounds.[5,6]

Vacuum assisted closure (VAC) therapy, also known as negative pressure wound therapy, has emerged as an advanced modality in wound care. It involves the application of controlled negative pressure to the wound bed through a sealed dressing system.[7] This technique promotes wound healing by enhancing local blood flow, reducing edema, removing excess exudate, decreasing bacterial colonization, and stimulating granulation tissue formation. VAC therapy has shown promising results in various types of chronic wounds, including diabetic foot ulcers.[8]

Despite the growing use of VAC therapy, its widespread adoption in resource-limited settings such as India remains variable due to concerns regarding cost, availability, and need for specialized equipment. Moreover, there is a need for robust comparative data evaluating its effectiveness against conventional dressing methods in the Indian patient population.[9,10]

Given this background, the present study aims to perform a comparative analysis of vacuum assisted closure therapy and conventional dressings in patients with chronic diabetic foot ulcers. The study focuses on evaluating key clinical outcomes including wound healing rate, infection control, duration of hospital stay, and requirement for surgical interventions, thereby providing evidence to guide optimal wound management strategies in tertiary care settings.

MATERIALS AND METHODS

Study design and setting:

This prospective comparative study was conducted in the Department of General Surgery at a tertiary care teaching hospital in India.

Study duration:

The study was carried out over a period of 12 months from January 2025 to December 2025.

Study population:

Patients presenting with chronic diabetic foot ulcers and admitted during the study period were screened for eligibility.

Sample size:

A total of 130 patients were included in the study and equally allocated into two groups:

- Vacuum assisted closure (VAC) therapy group (n = 65)
- Conventional dressing group (n = 65)

Inclusion Criteria:

- Patients aged ≥18 years
- Diagnosed cases of diabetes mellitus
- Presence of chronic diabetic foot ulcer (duration >4 weeks)
- Ulcers classified as Wagner grade II–IV
- Patients providing informed consent

Exclusion Criteria:

- Patients with Wagner grade I or grade V ulcers
- Presence of critical limb ischemia requiring immediate revascularization
- Osteomyelitis requiring primary amputation
- Malignancy in the ulcer
- Severe comorbid conditions limiting participation
- Patients unwilling to participate

Grouping and intervention:

Eligible patients were assigned into two equal groups:

VAC therapy group:

Patients in this group received vacuum assisted closure therapy using a standard negative pressure wound therapy system. After thorough wound debridement, sterile foam dressing was applied to the wound, sealed with an adhesive drape, and connected to a vacuum device. Continuous or intermittent negative pressure (typically −75 to −125 mmHg) was applied. Dressings were changed every 48–72 hours depending on wound condition.

Conventional dressing group:

Patients in this group received standard wound care consisting of regular saline dressings, antiseptic application when indicated, and sterile gauze coverage. Dressings were changed once or twice daily based on wound status.

All patients in both groups received standard care including glycemic control, antibiotic therapy based on culture sensitivity, offloading measures, and surgical debridement when required.

Outcome measures:

Primary outcomes

- Rate of wound size reduction
- Time to development of healthy granulation tissue

Secondary outcomes

- Duration of hospital stay
- Incidence of wound infection
- Requirement of repeated debridement
- Need for surgical interventions (skin grafting, minor or major amputation)

Assessment and follow-up:

Wound assessment was performed at baseline and at regular intervals during hospitalization. Parameters recorded included wound size (measured in cm^2), presence of granulation tissue, exudate level, and signs of infection. Patients were followed until wound closure, discharge, or surgical intervention.

Data collection:

Data were collected using a structured case record form, including demographic details, clinical history, ulcer characteristics, laboratory parameters, and treatment outcomes.

Statistical analysis:

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparisons between the two groups were performed using Student's t-test for continuous variables and Chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant.

Ethical considerations:

The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

RESULTS

A total of 130 patients with chronic diabetic foot ulcers were included in the study, with 65 patients in the vacuum assisted closure (VAC) therapy group and 65 patients in the conventional dressing group. The baseline demographic and clinical characteristics were comparable between the two groups, ensuring uniformity for outcome assessment.

The majority of patients belonged to the middle-aged and elderly population, with a higher prevalence among males. Most ulcers were classified as Wagner grade II and III, with a smaller proportion presenting with grade IV ulcers. The duration of diabetes and ulcer chronicity were comparable in both groups.

Patients treated with VAC therapy demonstrated a significantly faster rate of wound healing compared to those receiving conventional dressings. There was a marked reduction in wound size in the VAC group over the course of treatment, along with earlier appearance of healthy granulation tissue. The improved wound environment created by negative pressure therapy contributed to accelerated healing.

Infection control was more effective in the VAC group, with fewer patients developing persistent or worsening wound infections. The ability of VAC therapy to remove exudate and reduce bacterial load likely contributed to this outcome. Consequently, the need for repeated surgical debridement was lower in patients receiving VAC therapy.

The duration of hospital stay was notably shorter in the VAC group compared to the conventional dressing group, reflecting faster recovery and improved wound healing. Additionally, patients treated with VAC therapy required fewer surgical interventions, including skin grafting and amputations.

The incidence of both minor and major amputations was lower in the VAC group, indicating better limb salvage outcomes. Overall, VAC therapy demonstrated superior clinical effectiveness in managing chronic diabetic foot ulcers compared to conventional dressing methods.

Table 1: Age-wise distribution of study population

Age group (years)	VAC group (n=65)	Conventional group (n=65)	Total	Percentage (%)
18–40	10	12	22	16.9
41–50	18	17	35	26.9
51–60	22	20	42	32.3
>60	15	16	31	23.9

Table 1 shows that the majority of patients were in the 51–60 years age group, followed by 41–50 years.

Table 2: Gender distribution of patients

Gender	VAC group	Conventional group	Total	Percentage (%)
Male	44	42	86	66.2
Female	21	23	44	33.8

Table 2 shows male predominance in both groups.

Table 3: Wagner grade distribution of ulcers

Wagner grade	VAC group	Conventional group	Total	Percentage (%)
Grade II	28	26	54	41.5
Grade III	26	27	53	40.8
Grade IV	11	12	23	17.7

Table 3 shows that most ulcers were grade II and III.

Table 4: Mean wound size reduction (cm²)

Parameter	VAC group	Conventional group
Initial wound size (cm²)	18.6 ± 5.4	17.9 ± 5.1
Final wound size (cm²)	6.2 ± 3.1	10.8 ± 4.2
Mean reduction (cm²)	12.4 ± 3.8	7.1 ± 3.2

Table 4 shows greater reduction in wound size in VAC group.

Table 5: Time to development of healthy granulation tissue

Time (days)	VAC group	Conventional group
Mean ± SD	7.6 ± 2.3	13.2 ± 3.5

Table 5 shows faster granulation in VAC group.

Table 6: Infection rates in both groups

Infection status	VAC group	Conventional group
Present	18	32
Absent	47	33

Table 6 shows lower infection rates in VAC group.

Table 7: Requirement of repeated debridement

Debridement required	VAC group	Conventional group
Yes	20	38
No	45	27

Table 7 shows fewer repeat debridements in VAC group.

Table 8: Duration of hospital stay

Parameter	VAC group	Conventional group
Mean days ± SD	10.2 ± 3.1	16.8 ± 4.5

Table 8 shows shorter hospital stay in VAC group.

Table 9: Requirement of surgical intervention

Intervention required	VAC group	Conventional group
Yes	24	40
No	41	25

Table 9 shows fewer interventions in VAC group.

Table 10: Amputation rates

Type of amputation	VAC group	Conventional group
Minor	8	16
Major	4	10
None	53	39

Table 10 shows reduced amputations in VAC group.

Table 11: Glycemic control (HbA1c levels)

Parameter	VAC group	Conventional group
Mean HbA1c (%)	8.6 ± 1.2	8.8 ± 1.3

Table 11 shows comparable glycemic status in both groups.

Table 12: Overall outcome comparison

Outcome parameter	VAC group	Conventional group
Improved healing	52	34
Delayed healing	9	21
Non-healing	4	10

Table 12 shows superior outcomes in VAC group.

Table 1 shows that the majority of patients were clustered in the 51–60 years age group (42 patients, 32.3%), followed by 41–50 years (35 patients, 26.9%), indicating that diabetic foot ulcers were most prevalent in the middle-aged to elderly population. The distribution was comparable between VAC (22 vs 20) and conventional groups (22 vs 20), suggesting no age-related allocation bias affecting outcomes.

Table 2 shows a clear male predominance with 86 patients (66.2%) compared to 44 females (33.8%). Both groups had similar gender distribution (VAC: 44 males vs conventional: 42 males), indicating that gender did not act as a confounding variable in comparing treatment outcomes.

Table 3 shows that Wagner grade II (54 patients, 41.5%) and grade III (53 patients, 40.8%) ulcers constituted the majority of cases, with fewer grade IV ulcers (23 patients, 17.7%). The near-equal distribution across both groups confirms comparable baseline ulcer severity, ensuring that outcome differences are attributable to treatment modality rather than initial disease burden.

Table 4 demonstrates a markedly greater reduction in wound size in the VAC group (12.4 ± 3.8 cm^2) compared to the conventional dressing group (7.1 ± 3.2 cm^2). This indicates a significantly enhanced wound contraction and healing response with VAC therapy, likely due to improved perfusion and continuous exudate removal.

Table 5 shows that the mean time to development of healthy granulation tissue was substantially shorter in the VAC group (7.6 ± 2.3 days) compared to the conventional group (13.2 ± 3.5 days), reflecting accelerated transition from inflammatory to proliferative phase of wound healing with negative pressure therapy.

Table 6 shows a lower incidence of infection in the VAC group (18 patients, 27.7%) compared to the conventional group (32 patients, 49.2%). This nearly two-fold difference highlights the superior ability of VAC therapy to control bacterial load and maintain a cleaner wound environment.

Table 7 shows that repeated debridement was required in significantly fewer patients in the VAC group (20 patients, 30.8%) compared to the conventional group (38 patients, 58.5%), indicating better wound bed preparation and reduced necrotic tissue accumulation with VAC therapy.

Table 8 shows that the mean duration of hospital stay was considerably shorter in the VAC group (10.2 ± 3.1 days) compared to the conventional group (16.8 ± 4.5 days), reflecting faster clinical recovery, reduced complications, and improved efficiency of care.

Table 9 shows that surgical interventions were required in fewer patients in the VAC group (24 patients, 36.9%) compared to the conventional group (40 patients, 61.5%), indicating that VAC therapy reduces the need for invasive procedures by promoting effective wound healing.

Table 10 shows that total amputation rates (minor + major) were significantly lower in the VAC group (12 patients, 18.5%) compared to the conventional group (26 patients, 40.0%). Notably, major amputations were also fewer (4 vs 10), suggesting improved limb salvage outcomes with VAC therapy.

Table 11 shows comparable glycemic control between the two groups (VAC: 8.6 ± 1.2% vs conventional: 8.8 ± 1.3%), confirming that differences in outcomes were not influenced by variations in baseline metabolic status.

Table 12 shows a markedly higher proportion of improved healing in the VAC group (52 patients, 80.0%) compared to the conventional group (34 patients, 52.3%), along with lower rates of delayed healing (13.8% vs 32.3%) and non-healing ulcers (6.2% vs 15.4%). This reinforces the overall superiority of VAC therapy in achieving favorable wound outcomes.

Overall, the compiled data consistently demonstrate that VAC therapy offers significant advantages over conventional dressing across all major clinical endpoints, including wound healing rate, infection control, need for interventions, hospital stay, and limb salvage, without baseline differences between groups influencing the results.

DISCUSSION

The present study demonstrates that vacuum assisted closure (VAC) therapy is significantly more effective than conventional dressing methods in the management of chronic diabetic foot ulcers. The findings highlight improved wound healing dynamics, better infection control, reduced need for surgical interventions, shorter hospital stay, and enhanced limb salvage outcomes with VAC therapy.[11]

Diabetic foot ulcers are complex wounds characterized by impaired healing due to neuropathy, ischemia, and compromised immune response. Effective wound management requires not only infection control but also optimization of the wound microenvironment. Conventional dressings, while widely used, often fail to maintain an optimal moist environment, inadequately manage exudate, and require frequent changes, which may delay healing in chronic wounds.[12]

VAC therapy, through the application of controlled negative pressure, creates a favorable wound healing environment by promoting angiogenesis, enhancing granulation tissue formation, and improving local blood flow.[13] In the present study, patients treated with VAC therapy showed a significantly greater reduction in wound size and earlier development of healthy granulation tissue. This reflects accelerated progression through the proliferative phase of wound healing, which is critical in chronic diabetic wounds.[14]

Infection is a major determinant of poor outcomes in diabetic foot ulcers. The study findings indicate that VAC therapy is associated with a lower incidence of wound infection compared to conventional dressings. The continuous removal of exudate, reduction in bacterial colonization, and maintenance of a closed wound environment likely contribute to improved infection control. This also translates into a reduced requirement for repeated surgical debridement.[15]

Another important observation is the reduced need for surgical interventions in patients treated with VAC therapy. By promoting faster and more effective wound healing, VAC therapy minimizes the progression of tissue necrosis and limits the extent of surgical procedures required. This is particularly relevant in reducing both minor and major amputations, thereby improving limb preservation.[16,17]

The duration of hospital stay was significantly shorter in patients receiving VAC therapy, indicating faster clinical recovery and reduced burden on healthcare resources. Shorter hospitalization also has important implications for patient quality of life and overall treatment cost, especially in resource-limited settings.[18]

Glycemic control was comparable between the two groups, suggesting that the observed differences in outcomes were primarily attributable to the wound management modality rather than systemic metabolic factors. This strengthens the validity of VAC therapy as an independent contributor to improved healing outcomes.[19,20]

From a clinical perspective, VAC therapy offers a practical and effective approach to managing complex diabetic foot ulcers in tertiary care settings. Although initial costs and resource requirements may be higher than conventional dressings, the overall benefits in terms of faster healing, reduced complications, and decreased need for interventions may offset these concerns.[21,22]

However, VAC therapy should be integrated into a comprehensive management strategy that includes optimal glycemic control, infection management, offloading, and timely surgical intervention when required. A multidisciplinary approach remains essential for achieving the best outcomes in patients with diabetic foot ulcers.

Overall, the findings of this study support the superiority of vacuum assisted closure therapy over conventional dressing methods and emphasize its role as an advanced wound care modality in improving clinical outcomes in chronic diabetic foot ulcers.

Limitations

The present study has certain limitations that should be acknowledged while interpreting the findings. First, this was a single-center study conducted in a tertiary care hospital, which may limit the generalizability of the results to other healthcare settings, particularly primary and secondary care centers where resources and expertise may differ.

Second, although the sample size of 130 patients was adequate for comparative analysis, a larger sample size would have allowed for more robust subgroup analyses, especially across different Wagner grades and varying durations of diabetes. Multicentric studies with a larger cohort would provide stronger external validity.

Third, the study design was prospective comparative but not randomized. The absence of randomization may introduce selection bias, despite efforts to maintain comparable baseline characteristics between the two groups.

Fourth, long-term follow-up after discharge was not included in the study. Outcomes such as recurrence of ulcers, long-term limb salvage rates, and functional recovery could not be assessed, which are important parameters in diabetic foot management.

Fifth, cost-effectiveness analysis was not formally evaluated. Although VAC therapy demonstrated superior clinical outcomes, its economic implications, particularly in resource-limited settings, were not analyzed in detail.

Lastly, factors such as patient compliance, nutritional status, and variations in wound care practices outside the hospital setting were not systematically assessed, which could have influenced healing outcomes.

CONCLUSION

Vacuum assisted closure therapy is a superior wound management modality compared to conventional dressing methods in patients with chronic diabetic foot ulcers. It significantly enhances wound healing, promotes faster granulation tissue formation, reduces infection rates, decreases the need for repeated debridement and surgical interventions, shortens hospital stay, and improves limb salvage outcomes.

The findings of this study support the integration of VAC therapy into routine clinical practice in tertiary care settings for the management of complex diabetic foot ulcers. Its ability to provide a controlled wound environment and accelerate healing makes it a valuable tool in reducing morbidity associated with diabetic foot disease.

Despite higher initial costs, the overall clinical benefits and potential reduction in long-term complications suggest that VAC therapy may be a cost-effective option when used appropriately.

Further large-scale, randomized, multicentric studies with long-term follow-up are recommended to validate these findings and to evaluate the cost-effectiveness and broader applicability of VAC therapy across different healthcare settings.

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