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Original Research Article

Vacuum Dressing And Topical Antibacterial Dressing Among Patients With Diabetic Ulcer: A Comparative Study

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Abstract: *Diabetic foot ulcers (DFUs) represent a significant complication of diabetes mellitus, often leading to prolonged hospitalisation, amputations, and increased morbidity. Effective wound healing strategies are crucial in reducing the burden of diabetic foot ulcers (DFUs), particularly in resource-constrained settings such as Pakistan.AFG* ***Objective:*** *To compare the effectiveness of vacuum-assisted closure (VAC) dressing and topical antibacterial dressing in promoting granulation tissue formation and reducing healing time in patients with diabetic foot ulcers.* ***Methods:*** *A randomised controlled trial was conducted at the Department of General Surgery, University of Lahore Teaching Hospital, from July 2024 to December 2024. A total of 60 patients with clinically diagnosed diabetic foot ulcers were randomly assigned into two groups: Group A received a VAC dressing, while Group B received a topical antibacterial dressing (fusidic acid followed by saline gauze). Outcomes measured included the formation of granulation tissue within two weeks and the duration of complete wound healing. Data were analysed using SPSS version 25. A p-value of less than 0.05 was considered statistically significant.* ***Results:*** *The mean age of participants was 56.2 ± 9.4 years. Granulation tissue formation within two weeks was significantly higher in the VAC group (86.7%) compared to the topical dressing group (60%) (p = 0.018). The mean healing duration was shorter in the VAC group (12.3 ± 3.4 days) than in the topical group (17.6 ± 4.2 days) (p<0.001). Stratified analysis showed significantly better outcomes in patients with higher BMI, poor glycemic control, and non-smokers in the VAC group.* ***Conclusion:*** *VAC dressing significantly enhances granulation tissue formation and reduces healing time in patients with diabetic foot ulcers compared to topical antibacterial dressing. Its implementation in tertiary care hospitals in Pakistan could improve wound healing outcomes and reduce the burden of diabetic complications.*

Keywords: Diabetic Foot Ulcer, Negative Pressure Wound Therapy, Vacuum-Assisted Closure, Wound Healing, Granulation Tissue

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Introduction

Diabetic foot ulcers (DFUs) are among the most debilitating and costly complications of diabetes mellitus, leading to prolonged hospitalisation, limb amputation, and increased mortality. Globally, it is estimated that up to 25% of diabetic patients will develop a foot ulcer during their lifetime, with an annual incidence ranging from 1.0% to 4.1% in diabetic populations (1). In Pakistan, the prevalence of DFUs among hospitalised diabetic patients ranges between 11% and 24%, mainly due to poor glycemic control, limited access to specialised care, and delayed wound management (2,3).

Chronic wounds in diabetic patients often exhibit delayed healing due to microvascular insufficiency, impaired leukocyte function, and poor oxygenation (4). Conventional dressing methods, such as gauze and saline, remain widely used in low-resource settings, but these dressings are limited in their ability to promote rapid granulation and reduce bacterial burden (5). In contrast, vacuum-assisted closure (VAC) therapy, also known as negative pressure wound therapy (NPWT), has emerged as a promising modality that accelerates wound healing by reducing edema, improving tissue perfusion, and stimulating granulation tissue formation (6,7).

Recent international and regional studies have reported superior outcomes with VAC dressings compared to conventional moist dressings, particularly in terms of faster healing rates, decreased wound size, and reduced hospital stay duration (8, 9). A randomised trial from India demonstrated that VAC therapy significantly improved the rate of granulation tissue formation and reduced healing time in diabetic foot ulcers compared to saline gauze dressings (10). Likewise, studies from Iran and Egypt supported VAC therapy as a cost-effective and efficient alternative for managing large and complex diabetic ulcers (11, 12).

Despite growing evidence supporting the efficacy of VAC therapy, its utilisation remains limited in Pakistan, especially in public sector hospitals, where conventional dressings continue to be the mainstay of care due to concerns over affordability and accessibility (13). Furthermore, there is a paucity of well-structured, comparative, and context-specific data evaluating the effectiveness of VAC dressing versus topical antibacterial dressing in Pakistani patients with diabetic foot ulcers. This gap in the literature necessitates rigorous local studies to guide clinicians in evidence-based wound management practices.

Given the high burden of diabetes-related complications in Pakistan and the limited adoption of advanced wound care technologies, this study aims to evaluate and compare the clinical efficacy of vacuum-assisted dressing with topical antibacterial dressing in promoting granulation tissue formation and reducing healing duration in patients with diabetic foot ulcers. The results are expected to provide local evidence for formulating cost-effective, standardised treatment protocols that improve patient outcomes and reduce amputation rates.

Methodology

The present study was conducted as a randomised controlled trial at the Department of General Surgery, University of Lahore Teaching Hospital, and a tertiary care institution with an active diabetic foot clinic and wound care unit. The objective of the study was to compare the efficacy of vacuum-assisted closure (VAC) dressing with topical antibacterial dressing in patients with diabetic foot ulcers in terms of granulation tissue formation and duration of wound healing. The study duration extended

over six months, from July 2024 to December 2024, following ethical approval from the institutional review board of the University of Lahore. Patients aged between 30 and 65 years with a known history of type 2 diabetes mellitus and clinically diagnosed diabetic foot ulcers larger than 2 cm² in size and present for more than 4 weeks were included. Only patients with grade II or III diabetic foot ulcers, as classified by the Wagner system, were considered eligible. Patients with coexisting osteomyelitis, malignant ulcers, ischemic ulcers, peripheral vascular disease, or those receiving corticosteroids, chemotherapy, or immunosuppressive drugs were excluded. Pregnant and lactating women were also excluded from participation.

A total of 60 patients who fulfilled the inclusion and exclusion criteria were enrolled and randomly assigned into two groups using the sealed envelope method. Group A received a VAC dressing, which was applied continuously with a negative pressure of 125 mmHg using a closed-system suction device. Dressings were changed every 48 to 72 hours based on wound exudate and clinical evaluation. Group B received a topical antibacterial dressing comprising fusidic acid ointment applied to the wound bed, followed by a saline-soaked gauze dressing changed daily. Both groups received standard diabetic care and glycemic control as per hospital protocol.

The primary outcome measures were granulation tissue formation within two weeks and the duration (in days) required for complete wound healing. Granulation tissue formation was assessed clinically by the presence of healthy, red, and vascular tissue covering the wound bed. Complete healing was defined as the absence of wound discharge with epithelialisation of the ulcer. Data on age, gender, BMI, HbA1c, duration of diabetes, smoking history, and presence of comorbidities, such as hypertension, were recorded on a structured proforma.

All collected data were entered into SPSS version 25 for statistical analysis. Descriptive statistics, including mean and standard deviation, were calculated for continuous variables such as age, BMI, HbA1c, and healing duration. Frequencies and percentages were computed for categorical variables. Chi-square tests and Fisher's exact tests were used to assess associations between categorical variables, and an independent sample t-test was applied to compare means. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 patients diagnosed with diabetic foot ulcers were included in this study at the Department of General Surgery, University of Lahore Teaching Hospital. The mean age of the participants was 56.2 ± 9.4 years, with a male predominance of 63.3%. Patients were randomly assigned into two groups of 30 each: one receiving a vacuum-assisted closure (VAC) dressing and the other a topical antibacterial dressing (fusidic acid followed by saline-soaked gauze). Baseline demographic and clinical characteristics are presented in Table 1. In terms of treatment efficacy, the study assessed granulation tissue formation within 2 weeks and total duration for complete healing. Outcomes are detailed in Table 2. The VAC group had a significantly higher rate of granulation tissue formation and shorter mean healing time compared to the topical dressing group. These differences were statistically significant, highlighting the clinical superiority of VAC dressing. Stratified analysis was conducted to examine treatment success based on key comorbid factors, including HbA1c levels, BMI, and smoking status (Table 3). The stratified analysis suggests VAC dressing is particularly effective in patients with higher BMI and non-smokers, and also demonstrates a beneficial trend in patients with lower HbA1c levels.

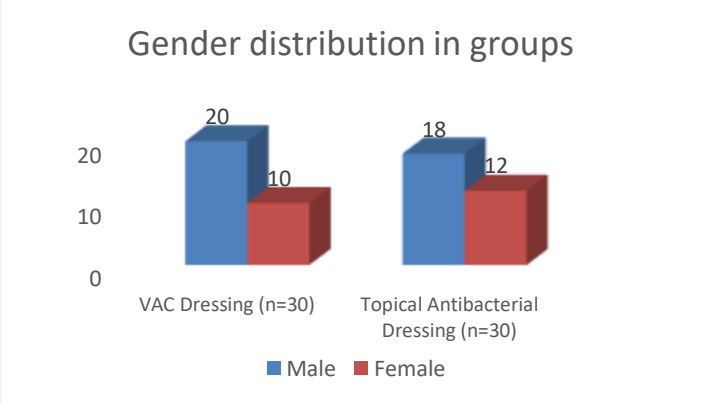

Figure 1: Distribution of gender among the groups.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 60)

Variable	VAC Dressing (n=30)	Topical Antibacterial Dressing (n=30)	Total (n=60)
Mean Age (years)	56.7 ± 9.2	55.6 ± 9.6	56.2 ± 9.4
Gender			
- Male	20 (66.7%)	18 (60%)	38 (63.3%)
- Female	10 (33.3%)	12 (40%)	22 (36.7%)
HbA1c (%)	7.9 ± 1.4	8.1 ± 1.6	8.0 ± 1.5
Duration of diabetes (years)	8.7 ± 3.2	9.2 ± 3.6	8.9 ± 3.4
BMI (kg/m²)	27.5 ± 3.6	26.8 ± 3.8	27.2 ± 3.7
Ulcer Size >2 cm²	30 (100%)	30 (100%)	60 (100%)
Ulcer Duration >4 weeks	30 (100%)	30 (100%)	60 (100%)
Hypertension	12 (40%)	10 (33.3%)	22 (36.7%)
Smoking History	8 (26.7%)	6 (20%)	14 (23.3%)

Table 2: Treatment Outcomes between VAC and Topical Antibacterial Dressing Groups

Outcome	VAC Dressing (n=30)	Topical Dressing (n=30)	p-value
Granulation Tissue Formation within 2 Weeks	26 (86.7%)	18 (60%)	0.018
Mean Duration of Complete Healing (days)	12.3 ± 3.4	17.6 ± 4.2	<0.001

Table 3: Stratified Analysis of Treatment Success by Clinical Variables

Variable	VAC Success (n=26)	Topical Success (n=18)	p-value
HbA1c < 8%	18/20 (90%)	10/14 (71.4%)	0.12
HbA1c ≥ 8%	8/10 (80%)	8/16 (50%)	0.043
BMI < 25 kg/m²	10/12 (83.3%)	7/10 (70%)	0.48
BMI ≥ 25 kg/m²	16/18 (88.9%)	11/20 (55%)	0.022
Smokers	6/8 (75%)	3/6 (50%)	0.37
Non-smokers	20/22 (90.9%)	15/24 (62.5%)	0.014

Discussion

This study compared the efficacy of vacuum-assisted closure (VAC) dressing and topical antibacterial dressing in patients with diabetic foot ulcers in a Pakistani tertiary care setting. Our results demonstrated that VAC therapy significantly outperformed conventional topical dressing in promoting granulation tissue formation and reducing the mean healing time. Granulation tissue formation was observed in 86.7% of patients treated with VAC within two weeks, compared to 60% in the topical dressing group ($p = 0.018$). Additionally, the mean duration of complete wound healing in the VAC group was 12.3 ± 3.4 days, significantly shorter than 17.6 ± 4.2 days observed in the topical dressing group ($p<0.001$).

These findings align with previous international research that underscores the benefits of VAC therapy in diabetic foot management. A randomised controlled trial by Ravari et al. demonstrated granulation tissue formation in 80% of VAC-treated patients, compared to 58% in the conventional dressing group, with faster wound closure in the VAC group ($p = 0.001$) (14). Similarly, a meta-analysis by Liu et al. involving 14 RCTs and over 1,000 participants concluded that VAC significantly reduced wound healing time and increased the rate of complete wound closure compared to moist dressings (15).

Stratified analysis in our study revealed that VAC therapy had superior efficacy in patients with HbA1c $\geq$ 8% (granulation in 80% vs 50% with topical dressing; $p = 0.043$) and in patients with a BMI $\geq$ 25 kg/m² (success rate, 88.9% vs 55%; $p = 0.022$). These observations suggest that VAC therapy may be particularly effective in metabolically compromised individuals. A study by Ebrahimzadeh et al. also reported better outcomes with VAC in diabetic patients with poor glycemic control, supporting our findings (16).

Furthermore, our results showed that non-smokers responded more favorably to VAC therapy (90.9% vs. 62.5%, $p = 0.014$). Smoking is known to impair angiogenesis and collagen deposition, leading to delayed wound healing (17). In a prospective study conducted in India, VAC therapy was reported to be significantly more effective in non-smokers, with a healing rate of 85% compared to 60% in smokers (18).

Regarding cost-effectiveness and feasibility, a study from Egypt found that although the initial cost of VAC therapy was higher, the shorter healing time resulted in a reduced total cost of care and hospital stay (19).

In Pakistan, where public hospitals face resource limitations, these findings are particularly relevant. The reduced healing time observed in our study (mean difference of 5.3 days) could translate into decreased hospitalisation costs and improved bed turnover.

Overall, our study reaffirms the clinical superiority of VAC dressing in terms of faster healing and better outcomes in diabetic foot ulcers, particularly among patients with poor metabolic profiles. The consistent results across various populations and clinical settings suggest that VAC therapy should be considered a standard care modality in managing chronic diabetic wounds, especially in resource-limited settings like Pakistan.

Conclusion

Vacuum-assisted dressing is a more effective treatment for diabetic foot ulcers compared to topical antibacterial dressings, especially in promoting faster granulation and reducing healing time. Its application in Pakistan's tertiary care settings may enhance patient outcomes and decrease complication rates.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-TCHL-23)

Consent for publication
Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final manuscript version. They are also accountable for the integrity of the study.

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