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EFFECTIVENESS OF VACUUM ASSISTED CLOSURE DRESSING TECHNIQUE VERSUS CONVENTIONAL DRESSING ON DIABETIC FOOT WOUND HEALING

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ABSTRACT

Background: Diabetic foot ulcers are among the most serious complications of diabetes mellitus and are associated with prolonged hospitalization, increased healthcare costs, and a higher risk of lower-limb amputation. Vacuum-assisted closure (VAC) therapy has emerged as an advanced wound management technique that may enhance wound healing compared with conventional dressing methods.

Objective: To compare the effectiveness of vacuum-assisted closure therapy versus conventional dressing in diabetic foot wound healing.

Methods: A comparative prospective study was conducted in the Department of Surgery of Govt. Teaching Hospital Shahdara Lahore from May 2025 to September 2025. A total of 100 patients diagnosed with diabetic foot ulcers were enrolled and divided equally into two groups. Group A received vacuum-assisted closure therapy, while Group B received conventional saline gauze dressing. Wound healing outcomes were assessed based on reduction in wound size, duration of hospital stay, granulation tissue formation, infection control, and time to wound closure. Data were analyzed using SPSS version 26.0. A p-value of <0.05 was considered statistically significant.

Results: The mean age of participants was 54.7 ± 9.6 years, with males constituting 62% of the study population. Patients treated with VAC therapy demonstrated significantly greater reduction in wound size (68.4% vs. 41.2%, $p<0.001$), earlier granulation tissue formation (12.3 ± 3.1 days vs. 20.5 ± 4.6 days, $p<0.001$), and shorter hospital stay (14.2 ± 5.4 days vs. 22.7 ± 6.8 days, $p<0.001$) compared to the conventional dressing group. Infection rates were also lower in the VAC therapy group.

Conclusion: Vacuum-assisted closure therapy is more effective than conventional dressing in promoting diabetic foot wound healing. VAC therapy significantly improves granulation tissue formation, reduces wound size, shortens hospital stay, and lowers infection rates. The technique may be considered a superior alternative for the management of diabetic foot ulcers.

KEYWORDS: Diabetic foot ulcer; Vacuum-assisted closure; Conventional dressing; Wound healing; Negative pressure wound therapy; Diabetes mellitus.

INTRODUCTION

Diabetes mellitus is a major global public health concern associated with substantial morbidity and mortality. Among its chronic complications, diabetic foot ulcers (DFUs) represent one of the most severe and disabling conditions affecting diabetic patients worldwide [1]. Diabetic foot ulcers are defined as non-healing wounds occurring below the ankle in patients with diabetes and are commonly associated with peripheral neuropathy, peripheral vascular disease,

and infection [2]. The prevalence of diabetic foot ulcers has increased significantly due to the rising incidence of diabetes, sedentary lifestyles, obesity, and aging populations [3]. It is estimated that approximately 15–25% of diabetic patients develop a foot ulcer during their lifetime, and these ulcers frequently lead to prolonged hospitalization and lower limb amputation [4].

Diabetic foot wounds impose a significant socioeconomic burden on healthcare systems because of recurrent hospital admissions, long-term treatment requirements, and rehabilitation costs [5]. In developing countries, limited healthcare resources and delayed patient presentation further worsen treatment outcomes [6]. Poor glycemic control, inadequate foot care, smoking, peripheral arterial disease, and infection are major risk factors contributing to delayed wound healing in diabetic patients [7]. Chronic diabetic wounds are characterized by impaired angiogenesis, prolonged inflammation, reduced collagen synthesis, and poor tissue oxygenation, all of which delay normal healing processes [8].

Conventional wound dressing techniques, including saline gauze dressing and antiseptic dressing, have long been used in the management of diabetic foot ulcers [9]. These methods aim to maintain a moist wound environment, prevent infection, and promote tissue repair. However, conventional dressings often require frequent changes and may not effectively remove exudates or reduce bacterial contamination [10]. Consequently, healing may be prolonged, increasing the risk of infection and amputation [11]. Therefore, advanced wound care techniques have gained considerable attention in recent years to improve diabetic foot management outcomes.

Vacuum-assisted closure (VAC) therapy, also known as negative pressure wound therapy (NPWT), is an innovative wound management technique increasingly used in diabetic foot care [12]. VAC therapy involves the application of controlled negative pressure to the wound surface through a sealed dressing connected to a vacuum pump [13]. This negative pressure promotes wound healing by removing excess fluid, reducing edema, increasing local blood flow, stimulating granulation tissue formation, and decreasing bacterial colonization [14]. The therapy also enhances cellular proliferation and angiogenesis, thereby accelerating tissue repair [15].

Several clinical studies have demonstrated the effectiveness of VAC therapy in improving diabetic wound healing compared with conventional dressing methods [16]. VAC therapy has been associated with faster wound contraction, shorter hospital stay, reduced infection rates, and improved patient satisfaction [17]. Armstrong and Lavery reported that negative pressure wound therapy significantly increased the rate of wound closure in diabetic foot ulcers compared to standard moist wound care [18]. Similarly, Blume et al. observed enhanced granulation tissue formation and lower amputation rates among patients treated with VAC therapy [19].

Despite its advantages, VAC therapy may not be universally accessible due to its cost and the need for specialized equipment and trained personnel [20]. In low- and middle-income countries, conventional dressing remains the primary treatment option in many healthcare settings [21]. Therefore, comparative studies assessing the effectiveness of VAC therapy and conventional dressing are essential to guide evidence-based clinical practice and optimize resource utilization [22].

The management of diabetic foot ulcers requires a multidisciplinary approach involving surgeons, diabetologists, nurses, wound care specialists, and physiotherapists [23]. Early identification and appropriate treatment of diabetic foot wounds are critical in preventing severe complications such as gangrene and limb amputation [24]. Although several international studies have investigated the role of VAC therapy in diabetic wound healing, limited local data are available regarding its effectiveness in comparison to conventional dressing methods.

Therefore, the present study was conducted to compare the effectiveness of vacuum-assisted closure therapy versus conventional dressing in diabetic foot wound healing. The study aimed to evaluate wound size reduction, granulation tissue formation, duration of hospital stay, infection control, and overall healing outcomes among patients treated with the two dressing techniques.

METHODOLOGY

A prospective comparative study was conducted in the Department of General Surgery at a tertiary care hospital during May 2025 to September 2025. The study included 100 patients diagnosed with diabetic foot ulcers who met the inclusion criteria. Patients aged between 30 and 70 years with Wagner grade I–III diabetic foot ulcers were enrolled in the study using a non-probability consecutive sampling technique. Patients with severe peripheral vascular disease, osteomyelitis, malignancy, or critically ill conditions were excluded from the study. After obtaining informed consent, participants were randomly divided into two equal groups of 50 patients each. Group A received vacuum-assisted closure (VAC) therapy, while Group B was treated with conventional saline gauze dressing. Detailed demographic and clinical data, including age, gender, duration of diabetes, wound size, and infection status, were recorded using a structured proforma. Wound assessment was performed regularly to evaluate reduction in wound size, granulation tissue formation, infection control, duration of hospital stay, and time to wound closure. Dressings were changed according to standard treatment protocols in both groups. Data were analyzed using SPSS version 26.0. Quantitative variables were presented as mean ± standard deviation, while qualitative variables were expressed as frequencies and percentages. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 100 patients with diabetic foot ulcers were included in the study and were equally divided into two groups. Group A consisted of 50 patients treated with vacuum-assisted closure (VAC) therapy, while Group B included 50 patients managed with conventional saline dressing. Demographic characteristics, wound healing progression, infection rates, and duration of hospital stay were analyzed and compared between the two groups.

The mean age of participants was 54.7 ± 9.6 years, with the majority of patients belonging to the age group of 51–60 years. Male patients constituted 62% of the study population, whereas females accounted for 38%. Baseline demographic variables and ulcer characteristics were comparable between both groups, with no statistically significant difference observed ($p>0.05$).

Patients treated with VAC therapy demonstrated significantly better wound healing outcomes than those receiving conventional dressing. The mean reduction in wound size in the VAC therapy group was 68.4% compared to 41.2% in the conventional dressing group ($p<0.001$). Furthermore, healthy granulation tissue appeared earlier among VAC-treated patients, with a mean duration of 12.3 ± 3.1 days compared to 20.5 ± 4.6 days in the conventional dressing group.

Infection control was also more favorable in the VAC therapy group. Only 10% of patients in Group A developed wound infections during treatment compared to 28% in Group B. Reduced wound exudate and improved tissue perfusion associated with negative pressure wound therapy may have contributed to lower infection rates.

The average duration of hospital stay was significantly shorter among patients treated with VAC therapy. Patients in Group A had a mean hospital stay of 14.2 ± 5.4 days, whereas those in Group B remained hospitalized for an average of 22.7 ± 6.8 days ($p<0.001$). Shorter hospitalization reflects faster wound healing and reduced need for prolonged wound management among patients receiving VAC therapy.

Overall, the findings indicate that vacuum-assisted closure therapy is superior to conventional dressing in enhancing diabetic foot wound healing, promoting granulation tissue formation, reducing infection rates, and decreasing hospital stay duration.

Table 1. Demographic Characteristics of Study Participants (n=100)

Variable	VAC Therapy Group (n=50)	Conventional Dressing Group (n=50)	p-value
Mean Age (years)	55.1 ± 8.9	54.3 ± 10.2	0.672
Male, n (%)	32 (64%)	30 (60%)	0.684
Female, n (%)	18 (36%)	20 (40%)	0.684
Duration of Diabetes (years)	9.4 ± 3.7	8.9 ± 4.1	0.541
Smokers, n (%)	15 (30%)	17 (34%)	0.667

Table 2. Comparison of Wound Healing Outcomes Between Groups

Outcome Variable	VAC Therapy Group	Conventional Dressing Group	p-value
Mean Reduction in Wound Size (%)	68.4 ± 12.6	41.2 ± 11.3	<0.001
Granulation Tissue Formation (days)	12.3 ± 3.1	20.5 ± 4.6	<0.001
Time to Wound Closure (days)	24.8 ± 5.7	38.6 ± 7.4	<0.001

Table 3. Infection Rates and Complications

Variable	VAC Therapy Group (n=50)	Conventional Dressing Group (n=50)	p-value
Wound Infection, n (%)	5 (10%)	14 (28%)	0.021
Need for Debridement, n (%)	8 (16%)	18 (36%)	0.018
Minor Amputation, n (%)	2 (4%)	7 (14%)	0.081

Table 4. Hospital Stay Duration and Treatment Outcomes

Variable	VAC Therapy Group	Conventional Dressing Group	p-value
Mean Hospital Stay (days)	14.2 ± 5.4	22.7 ± 6.8	<0.001
Complete Healing Achieved, n (%)	42 (84%)	30 (60%)	0.007
Patient Satisfaction Score	8.4 ± 1.2	6.3 ± 1.5	<0.001

DISCUSSION

The present study evaluated the effectiveness of vacuum-assisted closure therapy compared with conventional dressing in diabetic foot wound healing. The findings demonstrated that VAC therapy significantly improved wound healing outcomes, including greater reduction in wound size, earlier granulation tissue formation, reduced infection rates, and shorter hospital stay. These findings support the growing evidence that negative pressure wound therapy is superior to conventional dressing techniques in the management of diabetic foot ulcers14.

Diabetic foot ulcers remain a major cause of morbidity among diabetic patients worldwide and are strongly associated with poor quality of life and increased risk of lower extremity amputation [22]. Delayed wound healing in diabetic patients is primarily attributed to neuropathy, ischemia, impaired immune function, and chronic inflammation [23]. Effective wound management strategies are therefore essential to minimize complications and improve patient outcomes [14].

In the current study, patients treated with VAC therapy demonstrated significantly faster wound contraction compared with those receiving conventional saline dressing. This finding is consistent with previous studies that reported accelerated wound healing associated with negative pressure wound therapy [5]. The mechanism behind this improvement may involve enhanced local blood circulation, removal of excess wound exudate, and stimulation of angiogenesis and fibroblast proliferation [6]. VAC therapy creates a controlled subatmospheric pressure environment that promotes tissue granulation and cellular repair [7].

Granulation tissue formation occurred earlier in the VAC therapy group than in the conventional dressing group. Similar findings were reported by Blume et al., who found that VAC-treated wounds developed healthy granulation tissue more rapidly than wounds managed with standard dressings [8]. Faster granulation tissue formation is clinically important because it prepares the wound bed for closure and decreases the risk of infection [9]. VAC therapy may also improve oxygen delivery to tissues, thereby enhancing collagen synthesis and wound remodeling [10].

The study also observed lower infection rates among patients treated with VAC therapy. Diabetic foot wounds are highly susceptible to infection due to impaired immune responses and reduced tissue perfusion [11]. Conventional dressings may retain moisture and bacteria within the wound environment if not changed regularly [12]. In contrast, VAC therapy continuously removes wound exudates and reduces bacterial colonization, contributing to improved infection control [13]. Several previous studies have similarly demonstrated reduced microbial load and lower rates of wound infection with VAC therapy [14].

Hospital stay duration was significantly shorter among patients receiving VAC therapy. Reduced hospitalization is beneficial for both patients and healthcare systems because it lowers treatment costs and decreases the burden on hospital resources [15]. Previous literature has shown that patients undergoing negative pressure wound therapy often require fewer dressing changes and experience earlier wound closure, which contributes to shorter inpatient stays [16]. This finding is particularly relevant in resource-limited healthcare settings where prolonged hospitalization imposes substantial economic strain [17].

The findings of the present study are also supported by Armstrong and Lavery, who demonstrated higher healing rates and fewer amputations among diabetic foot ulcer patients treated with VAC therapy [18]. Similarly, Eginton et al. found that VAC therapy significantly accelerated healing of large diabetic wounds compared to moist gauze dressings [19]. The consistency of these findings across multiple studies indicates that VAC therapy is an effective adjunctive treatment for diabetic wound management.

Despite its clinical benefits, VAC therapy has certain limitations. The cost of specialized equipment and dressing materials may limit its widespread use in low-income healthcare settings [20]. In addition, proper application of VAC systems requires trained healthcare personnel and regular monitoring to prevent complications such as bleeding or tissue damage [21]. Some patients may also experience discomfort during dressing changes [22]. Therefore, healthcare providers must carefully assess patient suitability before initiating VAC therapy.

The study has several strengths, including direct comparison of two commonly used wound management techniques and assessment of multiple clinical outcomes. However, certain limitations should also be acknowledged. The study was conducted in a single healthcare center with a relatively small sample size, which may limit the generalizability of findings. Long-term follow-up was not performed to assess recurrence rates and long-term wound outcomes [24]. Future multicenter randomized controlled trials with larger sample sizes are recommended to further validate the effectiveness of VAC therapy in diabetic foot management.

Overall, the findings of the present study indicate that vacuum-assisted closure therapy is more effective than conventional dressing in promoting diabetic foot wound healing. VAC therapy enhances granulation tissue formation, reduces infection rates, shortens hospital stay, and accelerates wound closure. Incorporating VAC therapy into routine diabetic wound care protocols may substantially improve patient outcomes and reduce the burden of diabetic foot complications.

CONCLUSION

The present study concludes that vacuum-assisted closure (VAC) therapy is significantly more effective than conventional dressing in the management of diabetic foot ulcers. VAC therapy demonstrated superior outcomes in

terms of faster wound healing, greater reduction in wound size, earlier formation of healthy granulation tissue, lower infection rates, and reduced duration of hospital stay. Additionally, patients in the VAC group showed higher overall treatment satisfaction. These findings suggest that VAC therapy should be considered a preferred modality in diabetic foot wound management, particularly in cases requiring accelerated healing and improved clinical outcomes. Further large-scale studies are recommended to validate these results.

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