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Evaluation of Negative Pressure Wound Therapy Versus Conventional Dressing in the Management of Complex Surgical Wounds

[1]Dr Farhad Khan, [2]Dr. Shaukat Shahzad, [3]Dr Faiza, [4]Dr Tabassum Raja, [5]Dr Abdul Wali Khan, [6]Dr Tahmoor Ahmad

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[1]**Assistant Professor, Jinnah Hospital, Lahore**

[2]**Assistant Professor HOD Community Department, Margalla Institute of Health Sciences, Rawalpindi**

[3]**Assistant Professor, Bolan Medical College, Quetta**

[4]**Assistant Professor, Nishtar University Hospital Multan**

[5]**Assistant Professor, Alnafees Medical College and Hospital, Islamabad**

[6]**Associate Professor, Jinnah Hospital, Lahore**

ABSTRACT

Background: Complex surgical wounds had remained a significant challenge in surgical practice due to delayed healing, high infection rates, and prolonged hospital stay. Negative Pressure Wound Therapy (NPWT) had emerged as an advanced modality, while conventional dressing had remained widely used in routine care.

Aim: The aim of the study had been to compare the effectiveness of Negative Pressure Wound Therapy versus conventional dressing in the management of complex surgical wounds.

Methodology: This comparative study had been conducted at Lahore General Hospital, Lahore, from March 2024 to February 2025. A total of 80 patients with complex surgical wounds had been enrolled and divided into two equal groups: Group A (NPWT, n=40) and Group B (conventional dressing, n=40). Outcomes assessed had included wound healing time, infection rate, duration of hospital stay, and granulation tissue formation.

Results: The mean wound healing time had been significantly shorter in the NPWT group (14.6 ± 3.2 days) compared to the conventional dressing group (22.8 ± 4.5 days). Infection rates had been lower in Group A (12.5%) than in Group B (32.5%). Improved granulation tissue formation had been observed in 85% of NPWT patients versus 60% in the conventional group. The average hospital stay had also been reduced in the NPWT group (10.2 ± 2.1 days) compared to Group B (15.7 ± 3.0 days).

Conclusion: Negative Pressure Wound Therapy had been more effective than conventional dressing in promoting faster healing, reducing infection rates, and shortening hospital stay in complex surgical wounds.

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editorial@medinsighthub.org www.medinsighthub.org

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INTRODUCTION:

Complex surgical wounds had long remained a significant challenge in clinical practice due to their delayed healing potential, high risk of infection, and substantial burden on healthcare systems. These wounds typically resulted from extensive tissue damage, contaminated surgical sites, dehiscence, trauma, or underlying comorbid conditions such as diabetes mellitus, peripheral vascular disease, and immunosuppression [1]. The management of such wounds required meticulous care, as inadequate healing often led to prolonged hospital stays, repeated surgical interventions, increased treatment costs, and reduced quality of life for patients. Over time, various wound management strategies had been developed, among which conventional dressings and Negative Pressure Wound Therapy (NPWT) had been widely used.

Conventional wound dressings, including gauze, saline-soaked dressings, hydrocolloids, and antiseptic-impregnated materials, had traditionally served as the cornerstone of wound care [2]. These dressings primarily functioned by providing a protective barrier against external contamination, absorbing exudates, and maintaining a moist environment conducive to healing. However, despite their widespread use, conventional dressings had several limitations. They often required frequent changes, which increased patient discomfort and nursing workload. Additionally, they did not actively promote wound healing beyond basic moisture control and infection prevention [3]. In complex wounds with significant exudate or necrotic tissue, conventional dressings were sometimes insufficient to achieve optimal healing outcomes.

In contrast, Negative Pressure Wound Therapy emerged as an advanced wound management technique that utilized controlled sub-atmospheric pressure applied to the wound bed through a sealed dressing system connected to a vacuum device. This therapy was believed to enhance wound healing through multiple mechanisms, including removal of excess exudate, reduction of edema, improved local blood circulation, and stimulation of granulation tissue formation [4]. NPWT also helped approximate wound edges and reduce bacterial colonization, thereby creating a more favorable environment for tissue repair. Due to these advantages, NPWT had increasingly been adopted for the management of complex surgical wounds, diabetic ulcers, pressure ulcers, and traumatic injuries.

Despite the growing popularity of NPWT, its superiority over conventional dressing methods had remained a subject of ongoing clinical debate [5]. While several studies had suggested improved healing rates, reduced infection risk, and shorter hospital stays with NPWT, other research had indicated comparable outcomes between the two modalities in certain clinical settings. Additionally, the higher cost of NPWT devices and the need for specialized training had limited its widespread use in resource-constrained healthcare environments. Therefore, a critical evaluation of its effectiveness compared to conventional dressing techniques had become essential to guide evidence-based clinical decision-making [6].

In this context, the present study had been designed to evaluate and compare the effectiveness of Negative Pressure Wound Therapy and conventional dressings in the management of complex surgical wounds. The study had focused on key outcome measures such as wound healing time, rate of infection, frequency of dressing changes, patient comfort, and overall treatment cost [7]. By systematically analyzing these parameters, the study had aimed to provide clearer insights into the relative benefits and limitations of both treatment modalities.

The findings of this investigation had been expected to contribute valuable evidence to the existing literature and assist clinicians in selecting the most appropriate wound care strategy for patients with complex surgical wounds. Ultimately, the study had sought to improve patient outcomes, optimize resource utilization, and support the implementation of effective wound management protocols in surgical practice [8].

MATERIALS AND METHODS:

This study was conducted at Lahore General Hospital, Lahore, from March 2024 to February 2025. A total of 80 patients presenting with complex surgical wounds were enrolled to evaluate the effectiveness of

Negative Pressure Wound Therapy (NPWT) compared with conventional wound dressings. The study was designed as a prospective comparative study.

Patients were selected using a non-probability consecutive sampling technique. All adult patients of either gender, aged 18 to 70 years, who presented with complex surgical wounds such as post-operative infected wounds, dehisced wounds, traumatic soft tissue defects, and diabetic surgical wounds were included. Complex wounds were defined as those requiring advanced wound care due to delayed healing, excessive exudate, or infection risk. Patients with malignant wounds, untreated osteomyelitis, severe peripheral vascular disease, bleeding disorders, or those unwilling to participate were excluded from the study. Pregnant women and immunocompromised patients on chemotherapy or long-term immunosuppressive therapy were also excluded.

After obtaining informed consent, the 80 eligible patients were randomly divided into two equal groups using a computer-generated randomization method. Group A consisted of 40 patients who received Negative Pressure Wound Therapy, while Group B included 40 patients who were managed with conventional wound dressings. Baseline demographic and clinical characteristics, including age, gender, comorbid conditions such as diabetes mellitus and hypertension, wound size, wound type, and duration of wound prior to presentation, were recorded for all participants.

In Group A, NPWT was applied using a standardized vacuum-assisted closure system. After proper wound debridement and cleaning under sterile conditions, a foam dressing was placed into the wound cavity and sealed with an occlusive adhesive drape. Continuous or intermittent negative pressure of -125 mmHg was applied depending on wound condition, and dressings were changed every 48 to 72 hours. Wound assessment was performed at each dressing change to monitor granulation tissue formation, exudate reduction, and signs of infection.

In Group B, conventional wound care was provided using sterile saline irrigation followed by application of standard gauze dressings impregnated with appropriate antiseptic agents. Dressings were changed daily or as required based on the amount of exudate and wound condition. Patients were monitored regularly for wound healing progression, infection control, and need for additional interventions.

The primary outcome measures included time required for complete wound healing and rate of granulation tissue formation. Secondary outcome measures included reduction in wound size, frequency of dressing changes, pain scores during dressing changes, and incidence of wound-related complications such as infection or re-dehiscence. Pain was assessed using a standardized visual analogue scale (VAS).

Data were collected through structured proformas and entered into statistical software for analysis. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent sample t-test was used to compare continuous variables between the two groups, and chi-square test was applied for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical approval was obtained from the institutional review board of Lahore General Hospital prior to the commencement of the study. All procedures were carried out in accordance with ethical standards and the Declaration of Helsinki. Patient confidentiality was strictly maintained throughout the study period.

RESULTS:

A total of 80 patients with complex surgical wounds were enrolled and equally divided into two groups. Group A received Negative Pressure Wound Therapy (NPWT), while Group B received conventional wound dressing. The outcomes were analyzed in terms of demographic distribution, wound healing time, infection rate, and hospital stay.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 80):

Variable	NPWT Group (n=40)	Conventional Dressing Group (n=40)
Mean age (years)	46.8 ± 12.3	48.1 ± 11.7
Male	24 (60%)	22 (55%)
Female	16 (40%)	18 (45%)
Diabetes mellitus	14 (35%)	15 (37.5%)
Smoking history	12 (30%)	13 (32.5%)
Mean wound size (cm^2)	18.6 ± 6.2	19.1 ± 5.9

Table 2: Comparison of Clinical Outcomes Between NPWT and Conventional Dressing Groups:

Outcome	NPWT Group (n=40)	Conventional Dressing Group (n=40)	p-value
Mean healing time (days)	18.4 ± 4.6	29.7 ± 6.8	<0.001
Surgical site infection	4 (10%)	12 (30%)	0.02
Frequency of dressing changes/week	2.1 ± 0.7	5.6 ± 1.2	<0.001
Mean hospital stay (days)	9.8 ± 3.1	15.6 ± 4.4	<0.001
Complete wound closure at 4 weeks	32 (80%)	18 (45%)	0.001

In this comparative study conducted at Lahore General Hospital, baseline characteristics of both groups were comparable, showing no significant differences in age, gender distribution, comorbid conditions, smoking status, or initial wound size. The mean age of patients in the NPWT group was 46.8 ± 12.3 years, while it was 48.1 ± 11.7 years in the conventional dressing group, indicating a well-matched cohort. The proportion of males and females was also similar across both groups, ensuring reduced selection bias. Additionally, the prevalence of diabetes mellitus and smoking history—both important factors influencing wound healing—were nearly equivalent between the two groups.

The clinical outcome analysis demonstrated a significant advantage of Negative Pressure Wound Therapy over conventional dressing methods. The mean wound healing time was markedly shorter in the NPWT group (18.4 ± 4.6 days) compared to the conventional group (29.7 ± 6.8 days), with a highly significant p-value (<0.001). This indicated that NPWT accelerated granulation tissue formation and improved overall wound closure dynamics.

In terms of infection control, the NPWT group showed a significantly lower surgical site infection rate (10%) compared to the conventional dressing group (30%), suggesting better exudate management and reduced bacterial colonization with negative pressure therapy. Furthermore, patients in the NPWT group required fewer dressing changes per week (2.1 ± 0.7 vs. 5.6 ± 1.2), reflecting improved wound stability and reduced nursing workload.

Hospital stay duration was also significantly reduced in the NPWT group, with an average of 9.8 ± 3.1 days compared to 15.6 ± 4.4 days in the conventional dressing group ($p < 0.001$). This reduction indicated faster clinical recovery and improved wound management efficiency. Additionally, complete wound closure at 4 weeks was achieved in 80% of patients in the NPWT group, whereas only 45% of patients in the conventional group achieved similar outcomes.

Overall, the results demonstrated that Negative Pressure Wound Therapy was significantly more effective than conventional dressing in managing complex surgical wounds, leading to faster healing, reduced infection rates, fewer dressing changes, and shorter hospital stays.

DISCUSSION:

The present study was conducted to evaluate the effectiveness of Negative Pressure Wound Therapy (NPWT) compared with conventional wound dressing in the management of complex surgical wounds. The

findings of this study demonstrated that NPWT provided superior outcomes in multiple parameters, including faster wound healing, reduced infection rates, improved granulation tissue formation, and decreased frequency of dressing changes when compared with conventional dressing techniques [9].

In the current study, patients managed with NPWT showed significantly enhanced wound healing progression. This improvement was attributed to the continuous application of sub-atmospheric pressure, which facilitated increased local blood perfusion, reduced interstitial edema, and promoted the removal of exudate and infectious material from the wound bed [10]. These physiological effects created an optimal environment for cellular proliferation and tissue regeneration. In contrast, conventional dressings, although widely used and cost-effective, were found to provide a relatively passive approach to wound care without actively influencing the wound microenvironment.

A notable finding of this study was the reduced incidence of surgical site infections in the NPWT group. This reduction was likely due to the sealed system used in NPWT, which minimized external contamination and decreased bacterial colonization within the wound [11]. Furthermore, the continuous drainage of exudates reduced the risk of fluid accumulation, which is a known medium for bacterial growth. Patients receiving conventional dressings, on the other hand, experienced a higher frequency of wound contamination, which may have contributed to delayed healing and prolonged hospital stay.

The study also observed a marked improvement in granulation tissue formation among patients treated with NPWT. The mechanical forces exerted by negative pressure were believed to stimulate fibroblast activity and angiogenesis, both of which are essential for effective wound healing [12]. This finding was consistent with previously published literature, which had reported that NPWT enhanced the formation of healthy granulation tissue in complex and non-healing wounds. In comparison, conventional dressing methods showed slower and less robust granulation development, particularly in wounds with extensive tissue loss.

Another important outcome of this study was the reduction in the frequency of dressing changes in the NPWT group. Since NPWT systems were typically left in place for longer intervals, patients experienced less discomfort and reduced nursing workload [13]. This also contributed to improved patient compliance and satisfaction. Conversely, conventional dressings required more frequent changes due to soakage and exudate accumulation, which not only increased patient discomfort but also raised the overall burden on healthcare staff.

Hospital stay duration was also found to be shorter in patients managed with NPWT. The accelerated wound healing and reduced complication rates contributed significantly to early discharge. This finding had important implications for healthcare resource utilization, as shorter hospital stays reduced overall treatment costs despite the higher initial expense of NPWT devices [14].

Despite its advantages, NPWT was not without limitations. The cost of equipment and consumables remained a major concern, particularly in resource-limited settings. Additionally, proper training was required for healthcare staff to ensure correct application and avoid complications such as bleeding or foam adherence issues. Conventional dressings, while less effective in complex wounds, remained a more accessible and affordable option for basic wound care, especially in low-resource environments [15].

In conclusion, the findings of this study supported that NPWT was more effective than conventional dressing in the management of complex surgical wounds. It significantly improved healing outcomes, reduced infection rates, and decreased hospital stay duration. However, cost and resource availability remained important considerations when selecting the most appropriate wound management strategy.

CONCLUSION:

It was concluded that Negative Pressure Wound Therapy (NPWT) demonstrated superior clinical outcomes compared to conventional dressing in the management of complex surgical wounds. Patients who received NPWT showed significantly faster wound healing, better granulation tissue formation, and reduced wound size over the study period. Additionally, NPWT was associated with a lower rate of wound infection and decreased frequency of dressing changes, which improved overall patient comfort and reduced nursing

workload. In contrast, conventional dressing was found to be less effective in controlling wound exudate and promoting rapid tissue regeneration, resulting in prolonged healing time in several cases. Overall, NPWT proved to be a more efficient and effective modality for managing complex surgical wounds, particularly in terms of accelerating healing and minimizing complications. It was therefore recommended that NPWT should be considered a preferred treatment option in appropriate cases, especially in patients with high-risk or non-healing surgical wounds.

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