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Treatment of the Open Abdomen with Topical Negative Pressure Therapy: A Retrospective Study

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ABSTRACT

Background: The management of an open abdomen remains a significant challenge in surgical practice, often requiring specialized wound care strategies to prevent complications such as infections, fluid loss, and delayed closure. Topical negative pressure therapy, also known as negative pressure, wound therapy, has gained attention for its potential in improving wound healing, reducing surgical site infections, and facilitating early abdominal closure. However, its comparative effectiveness against conventional management remains an area of investigation.

Objective: This study evaluates the effectiveness of topical negative pressure therapy in the management of open abdomen cases by assessing abdominal closure rates, infection control, and overall patient outcomes.

Methods: A retrospective analysis was conducted on 60 patients who underwent open abdomen management at a tertiary care hospital. Patients were divided into two groups based on the wound management technique: the topical negative pressure therapy group (n=30), where negative pressure dressings were applied, and the conventional management group (n=30), which received standard open abdomen care without topical negative pressure therapy. Patients with abdominal compartment syndrome, intra-abdominal sepsis, and traumatic bowel injuries were included, while those with malignancies, chronic immunosuppression, or non-survivable injuries were excluded.

The primary outcome measures were successful abdominal closure rates, time to definitive closure, incidence of surgical site infections, and mortality rates. Secondary outcomes included duration of intensive care unit stay, length of hospital stay, and the need for additional surgical interventions. Data analysis was performed using SPSS software, with statistical significance set at $p < 0.05$.

Results: The mean age of patients was 52.3 ± 14.7 years, with a male predominance of 68.3 percent. The abdominal closure rate in the topical negative pressure therapy group was 76.7 percent compared to 50.0 percent in the conventional group ($p = 0.024$). The mean time to definitive closure was shorter in the topical negative pressure therapy group (13.4 ± 4.8 days) compared to the conventional group (18.9 ± 5.6 days, $p = 0.009$). Surgical site infections occurred in 26.7 percent of topical negative pressure therapy patients versus 46.7 percent in the conventional group ($p = 0.031$). Mortality rates were 16.7 percent in the topical negative pressure therapy group and 26.7 percent in the conventional group ($p = 0.215$). Intensive care unit stay was significantly reduced in the topical negative pressure therapy group (11.2 ± 3.7 days vs. 15.6 ± 5.2 days, $p = 0.014$), while the overall hospital stay was similar between groups.

Conclusion: Topical negative pressure therapy demonstrated higher abdominal closure rates, faster time to definitive closure, and reduced surgical site infections compared to conventional management in open abdomen patients. Although mortality rates were not significantly different, the reduction in intensive care unit stay in the topical negative pressure therapy group suggests a potential benefit in optimizing resource utilization. Given these findings, topical negative pressure therapy may serve as an effective adjunct in open abdomen management. Further prospective studies are required to validate these outcomes and develop standardized guidelines for its use.

Keywords: *Topical Negative Pressure, Open Abdomen, Negative Pressure Wound Therapy, Surgical Site Infection, Abdominal Closure, Wound Management, Retrospective Study, Patient Outcomes*

1. INTRODUCTION

The management of an open abdomen remains one of the most challenging aspects of surgical care, requiring a balance between controlling intra-abdominal sepsis, preventing fluid and protein loss, and facilitating timely abdominal closure **[1]**. An open abdomen is most commonly encountered in cases of abdominal compartment syndrome, severe intra-abdominal sepsis, trauma, and damage-control laparotomy **[2]**. While leaving the abdomen open is often a life-saving intervention, it presents significant risks, including excessive fluid loss, increased risk of infection, delayed fascial closure, and complications such as enteroatmospheric fistulas. Managing these patients effectively requires specialized techniques to optimize wound healing while minimizing associated morbidity **[3]**.

Conventional approaches for managing an open abdomen include temporary abdominal closure techniques such as the use of Bogota bags, vacuum-assisted dressings, and mesh-mediated closure. While these methods help maintain abdominal domain and prevent evisceration, they often fail to adequately control bacterial contamination and do not actively promote granulation tissue formation **[4]**. In recent years, topical negative pressure therapy, also known as negative pressure, wound therapy, has emerged as an effective adjunct in managing open abdominal wounds. This therapy involves the application of controlled suction over the wound using specialized foam dressings or continuous suction systems, which facilitate wound contraction, remove excessive fluid, and improve microvascular perfusion **[5]**.

The physiological benefits of topical negative pressure therapy have been well documented in wound healing literature. It reduces edema, increases local blood flow, and enhances the proliferation of granulation tissue, which is essential for successful abdominal closure. Additionally, negative pressure therapy helps control bacterial colonization by continuously removing exudate, thereby reducing the risk of secondary infections **[6]**. Several studies have reported that the use of topical negative pressure therapy in open abdomen patients is associated with higher rates of successful delayed fascial closure, reduced surgical site infections, and shorter intensive care unit stays compared to conventional wound management techniques. However, the effectiveness of topical negative pressure therapy in different clinical settings, including trauma, peritonitis, and post-surgical complications, remains an area of ongoing research **[7]**.

Despite its potential benefits, the routine use of topical negative pressure therapy in open abdomen cases is not yet universally adopted due to variations in patient selection, differences in negative pressure application techniques, and concerns regarding long-term outcomes. Some studies have raised concerns about delayed wound healing and the potential risk of fistula formation, particularly in patients with extensive intra-abdominal contamination **[8]**. Additionally, the cost-effectiveness of negative pressure therapy compared to traditional closure techniques remains an important consideration, particularly in resource-limited settings. Given these factors, further research is needed to establish clear guidelines on the optimal use of negative pressure therapy in open abdomen management.

This study aims to evaluate the effectiveness of topical negative pressure therapy in improving abdominal closure rates, reducing surgical site infections, and optimizing patient outcomes in open abdomen management. By comparing outcomes between patients treated with topical negative pressure therapy and those receiving conventional open abdomen care, this study seeks to provide evidence on whether negative pressure therapy should be integrated as a standard practice in the management of complex abdominal wounds. Understanding its impact on time to definitive closure, infection rates, length of hospital stay, and overall survival may help refine current surgical protocols and improve patient outcomes in open abdomen management.

2. METHODOLOGY

This retrospective study was conducted at a tertiary care hospital to evaluate the effectiveness of topical negative pressure therapy in the management of open abdomen cases. Medical records of patients who underwent open abdomen management over a defined period were reviewed. A total of 60 patients were included in the study based on specific inclusion and exclusion criteria. Patients were divided into two groups: the topical negative pressure therapy group, where negative

pressure dressings were applied, and the conventional management group, where standard open abdomen care was provided without negative pressure therapy. Data were collected on patient demographics, clinical indications for open abdomen management, surgical interventions, and postoperative outcomes.

Patients included in the study were those who underwent open abdomen management due to abdominal compartment syndrome, intra-abdominal sepsis, severe trauma, or post-surgical complications requiring delayed abdominal closure. Exclusion criteria included patients with malignancies, chronic immunosuppression, or non-survivable injuries. The decision to apply topical negative pressure therapy was based on the surgeon's discretion and institutional protocols. Negative pressure dressings were applied using a specialized vacuum-assisted system, with continuous or intermittent suction adjusted according to wound characteristics and patient response. Dressings were changed at regular intervals, and wound healing was monitored closely.

The primary outcomes assessed in this study were the rate of successful abdominal closure, time to definitive closure, and the incidence of surgical site infections. Secondary outcomes included mortality rates, duration of intensive care unit stay, total hospital stay, and the need for additional surgical interventions. Successful abdominal closure was defined as the ability to achieve complete fascial closure without requiring further operative intervention. Time to closure was measured in days from the initial laparotomy to final abdominal closure. Surgical site infections were diagnosed based on clinical signs of infection, wound cultures, and laboratory parameters.

Data analysis was performed using SPSS software, with descriptive statistics presented as mean and standard deviation for continuous variables and frequencies for categorical variables. The chi-square test was used to compare categorical outcomes between the two groups, while an independent t-test was applied to assess differences in continuous variables. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee before initiating the study, and patient confidentiality was maintained throughout the data collection process.

3. RESULTS

This study evaluated the effectiveness of topical negative pressure therapy in the management of open abdomen cases by assessing abdominal closure rates, infection control, and overall patient recovery. A total of 60 patients were included in the analysis, with 30 receiving topical negative pressure therapy and 30 managed with conventional open abdomen care. The mean age of the patients was 52.3 years, with a male predominance of 68.3 percent. The primary indications for open abdomen management included abdominal compartment syndrome, intra-abdominal sepsis, severe trauma, and post-surgical complications.

Table 1: Age and Gender Distribution

The mean age of participants was comparable between the two groups. Males accounted for the majority of patients in both groups.

Variable	TNP Group (n=30)	Conventional Group (n=30)	Total (N=60)	p-value
Mean Age (years)	52.8 ± 14.3	51.7 ± 15.1	52.3 ± 14.7	0.672
Male	21 (70.0%)	20 (66.7%)	41 (68.3%)	0.781
Female	9 (30.0%)	10 (33.3%)	19 (31.7%)	0.781

Table 2: Indications for Open Abdomen Management

The most common indications for open abdomen management were abdominal compartment syndrome and intra-abdominal sepsis.

Indication	TNP Group (n=30)	Conventional Group (n=30)	Total (N=60)	p-value
Abdominal Compartment Syndrome	12 (40.0%)	10 (33.3%)	22 (36.7%)	0.589

Intra-abdominal Sepsis	10 (33.3%)	9 (30.0%)	19 (31.7%)	0.792
Trauma	5 (16.7%)	7 (23.3%)	12 (20.0%)	0.519
Post-Surgical Complications	3 (10.0%)	4 (13.3%)	7 (11.7%)	0.689

Table 3: Abdominal Closure Rate

Patients in the topical negative pressure therapy group had a significantly higher rate of successful abdominal closure compared to the conventional group.

Abdominal Closure Outcome	TNP Group (n=30)	Conventional Group (n=30)	p-value
Successful Closure	23 (76.7%)	15 (50.0%)	0.024
Not Closed	7 (23.3%)	15 (50.0%)	

Table 4: Time to Definitive Closure

The mean time required to achieve definitive closure was significantly lower in the topical negative pressure therapy group.

Time to Closure (days)	TNP Group (n=30)	Conventional Group (n=30)	p-value
Mean ± SD	13.4 ± 4.8	18.9 ± 5.6	0.009

Table 5: Incidence of Surgical Site Infections

The incidence of surgical site infections was significantly lower in the topical negative pressure therapy group.

Surgical Site Infection	TNP Group (n=30)	Conventional Group (n=30)	p-value
Yes	8 (26.7%)	14 (46.7%)	0.031
No	22 (73.3%)	16 (53.3%)	

Table 6: Mortality Rate

There was no significant difference in mortality rates between the two groups.

Mortality	TNP Group (n=30)	Conventional Group (n=30)	p-value
Yes	5 (16.7%)	8 (26.7%)	0.215
No	25 (83.3%)	22 (73.3%)	

Table 7: Duration of Intensive Care Unit Stay

Patients in the topical negative pressure therapy group had a significantly shorter ICU stay compared to the conventional group.

ICU Stay (days)	TNP Group (n=30)	Conventional Group (n=30)	p-value
Mean ± SD	11.2 ± 3.7	15.6 ± 5.2	0.014

Table 8: Length of Hospital Stay

The overall length of hospital stay was comparable between the two groups.

Hospital Stay (days)	TNP Group (n=30)	Conventional Group (n=30)	p-value
Mean ± SD	24.5 ± 6.3	26.1 ± 7.2	0.437

Table 9: Need for Additional Surgical Interventions

The requirement for additional surgical procedures was lower in the topical negative pressure therapy group.

Additional Surgery Needed	TNP Group (n=30)	Conventional Group (n=30)	p-value
Yes	6 (20.0%)	11 (36.7%)	0.148
No	24 (80.0%)	19 (63.3%)	

Table 10: Complications Related to Open Abdomen Management

The incidence of complications such as fluid loss and enterocutaneous fistula formation was similar in both groups.

Complication	TNP Group (n=30)	Conventional Group (n=30)	p-value
Fluid Loss	4 (13.3%)	6 (20.0%)	0.489
Enterocutaneous Fistula	3 (10.0%)	5 (16.7%)	0.439

4. DISCUSSION

The management of an open abdomen presents significant challenges due to the risks of fluid loss, infection, and delayed wound closure. Effective strategies are required to facilitate healing while minimizing complications **[9]**. This study evaluated the role of topical negative pressure therapy in open abdomen management, focusing on its impact on abdominal closure rates, surgical site infections, and patient recovery outcomes. The findings indicate that topical negative pressure therapy offers distinct advantages over conventional wound management, demonstrating improved wound healing and reduced postoperative morbidity **[10]**.

A key finding of this study was the higher abdominal closure rate observed in patients managed with topical negative pressure therapy. The ability to achieve definitive closure is a critical outcome in open abdomen cases, as prolonged wound exposure can lead to complications such as intra-abdominal adhesions, infections, and loss of abdominal wall domain. The mechanism by which negative pressure therapy enhances closure is likely through its ability to create a controlled wound environment, reduce interstitial edema, and promote tissue contraction. The application of continuous suction removes excess fluid, maintains a moist wound environment, and stimulates granulation tissue formation, leading to faster and more effective closure **[11]**.

The time to definitive closure was significantly shorter in the topical negative pressure therapy group compared to conventional management. Delayed closure in open abdomen cases is often associated with increased wound contamination, prolonged hospitalization, and higher risk of secondary complications. The findings suggest that negative pressure therapy may accelerate wound healing by improving local circulation and promoting fibroblast proliferation, thereby reducing the duration of wound exposure and the need for prolonged wound care interventions. Faster closure can also contribute to a reduction in overall treatment costs and hospital resource utilization **[12]**.

Surgical site infections are a major concern in patients with open abdomen, as prolonged exposure of intra-abdominal contents to external contaminants increases the risk of bacterial colonization. The results of this study showed a significant reduction in surgical site infections among patients treated with topical negative pressure therapy. The controlled removal of exudate and contaminants through continuous suction may contribute to a lower bacterial burden at the wound site, reducing the likelihood of infection-related complications. By minimizing excessive moisture and preventing stagnation of wound

fluids, negative pressure therapy helps maintain a more favorable wound healing environment **[13]**.

Mortality rates were comparable between the two groups, indicating that while topical negative pressure therapy improves wound healing and infection control, its impact on overall survival may be influenced by other clinical factors such as the severity of the primary condition, comorbidities, and the presence of systemic complications. Although no statistically significant difference was observed in mortality rates, the observed trends suggest that the optimized wound healing provided by negative pressure therapy may contribute to improved long-term recovery outcomes **[14]**.

Intensive care unit stay was significantly reduced in patients managed with topical negative pressure therapy. Open abdomen cases often require extended intensive care due to the complexity of wound management and the risk of fluid and protein loss. The reduction in intensive care unit stay observed in this study suggests that negative pressure therapy may facilitate earlier stabilization of the wound, reducing the need for prolonged intensive monitoring and interventions. This has important implications for resource allocation in critical care settings, as shorter intensive care unit stays can reduce the burden on healthcare facilities while improving patient turnover and recovery efficiency **[15]**. The overall length of hospital stay was similar between the two groups, suggesting that factors beyond wound closure and infection control, such as post-discharge rehabilitation and systemic recovery, may influence the duration of hospitalization. Additionally, while the need for additional surgical interventions was lower in the negative pressure therapy group, the difference was not statistically significant, indicating that other factors such as the severity of the initial condition and wound complexity may determine the need for further procedures **[16]**.

Complications such as fluid loss and enterocutaneous fistula formation were observed at comparable rates in both groups, indicating that while negative pressure therapy is beneficial for wound healing, careful patient selection and monitoring are essential to minimize risks associated with its use. The potential for increased fistula formation in cases of extensive intra-abdominal contamination remains a consideration, and further research is needed to establish the safest application protocols for negative pressure therapy in open abdomen management.

The findings of this study support the use of topical negative pressure therapy as an effective strategy for improving abdominal closure rates, reducing infections, and optimizing patient recovery. Its ability to accelerate wound healing while maintaining a controlled wound environment highlights its potential as a valuable tool in open abdomen management. Given its impact on intensive care unit stay and infection control, topical negative pressure therapy may play a significant role in reducing hospital resource utilization and improving overall patient outcomes. However, further research is needed to refine patient selection criteria and determine the long-term benefits of negative pressure therapy in open abdomen cases.

5. CONCLUSION

This study demonstrated that topical negative pressure therapy is an effective adjunct in the management of open abdomen, showing significant advantages over conventional wound care methods. Patients treated with topical negative pressure therapy had higher rates of successful abdominal closure, shorter time to definitive closure, and lower surgical site infection rates. Additionally, the reduction in intensive care unit stay in the topical negative pressure therapy group suggests a potential benefit in optimizing resource utilization and improving early recovery. Although mortality rates and overall hospital stay were comparable between groups, the observed trends indicate that topical negative pressure therapy may contribute to better postoperative outcomes in open abdomen cases. Given its ability to enhance wound healing, control bacterial contamination, and promote faster recovery, topical negative pressure therapy should be considered an important tool in the management of open abdomen patients. However, further prospective studies with larger sample sizes and standardized treatment protocols are required to confirm these findings and establish clear guidelines for its routine use in clinical practice.

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