Original Research

A PROSPECTIVE STUDY TO COMPARE THE EFFICACY OF NEGATIVE PRESSURE WOUND THERAPY AND CONVENTIONAL TECHNIQUE IN THE MANAGEMENT OF OPEN ABDOMEN

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ABSTRACT

Introduction: Open abdomen refers to leaving abdominal wall unclosed after surgery or reopening due to abdominal compartment syndrome, severe infection, or trauma. It may result from damage control surgery, initially developed for trauma but now used broadly. It helps manage sepsis, prevent hypertension complications. Bjorck classified it into grades one to four.

Aims: To compare the outcomes of open abdomen closure using Negative Pressure Wound Therapy (NPWT) versus primary laparostomy, and to evaluate and compare the incidence, types of complications, and mortality between the two treatment approaches.

Materials and methods: This prospective comparative study evaluated patients with open abdomen managed by NPWT or primary laparostomy. Clinical data, including demographics, surgical details, complications, hospital stay, and mortality, were recorded and statistically analyzed to compare outcomes between groups.

Result: Group A (NPWT) showed better outcomes than Group B. Hospital stay, delayed primary closure, secondary healing, and enteral feeding were significantly shorter in Group A ($p<0.0001$). Ventral hernia ($p=0.03$) and overall complications ($p=0.001$) were lower in Group A, while mortality was not significant ($p=0.334$).

Conclusion: The study concludes that negative pressure wound therapy is a safe and effective method for managing post-laparotomy wound dehiscence and open abdomen, offering improved primary closure rates, shorter hospital stay, faster wound healing, and earlier return to enteral feeding compared to conventional treatment.

Keywords: Negative Pressure Wound Therapy (NPWT), Open Abdomen, Laparostomy, Wound Dehiscence, Conventional Technique.

INTRODUCTION

Open abdomen (OA) is a complex and challenging surgical condition encountered in patients undergoing emergency laparotomy, particularly in cases of trauma, peritonitis, severe intra-abdominal sepsis, and abdominal compartment syndrome. In this condition, the abdominal cavity is intentionally left open or reopened to prevent life-threatening complications and to allow adequate physiological stabilization.[1]

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Although this approach is life-saving, it is associated with significant clinical challenges, including fluid and protein loss, infection, entero-atmospheric fistula formation, and difficulty in achieving delayed fascial closure.[2]

Over the years, various temporary abdominal closure techniques have been developed to improve outcomes in patients with OA. Among these, Negative Pressure Wound Therapy (NPWT) has emerged as an advanced modality that helps in removing exudates, reducing edema, improving tissue perfusion, [3] and promoting granulation tissue formation. It has also been associated with higher rates of primary fascial closure and reduced wound-related complications. In contrast, conventional techniques such as primary

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laparostomy are still widely used, especially in resource-limited settings, but may be associated with prolonged healing time and higher morbidity.[4]
Despite the increasing use of NPWT,[5] there remains ongoing debate regarding its superiority over conventional methods in terms of clinical outcomes, complication rates, duration of hospital stay, and mortality. Therefore, a systematic comparison between these two approaches is essential to establish evidence-based practice.[6]
This prospective study aims to compare the efficacy of Negative Pressure Wound Therapy and conventional techniques in the management of open abdomen, with a focus on rates of abdominal closure, postoperative complications, length of hospital stay, and overall patient outcomes.[7,8]

MATERIALS AND METHODS

Study Design: Prospective study.
Place of Study: Khejurberia RH, khejurberia,Nandakumar, Purba medinipur, Westbengal.
Period of Study: 18 months from January 2019 to June 2020.
Study Population: The study includes 90 patients with open abdomen, divided into NPWT and conventional technique groups for comparative evaluation.
Sample Size: 90 patients
Inclusion Criteria: Patients undergoing emergency exploratory laparotomy developing open abdomen in post-operative period.
Exclusion Criteria:

1. Pregnant patients
2. Below the age of 12 years
3. Patients with open abdomen with concurrent entero-atmospheric fistula
4. Not giving consent

Study Variable:
The following variables were studied:

1. Age of the patient
2. Sex of the patient
3. Indication for emergency exploratory laparotomy
4. Presence / absence of sepsis: Normal WBC count 4000/uL – 12000/uL
5. Co – morbidities (Hypertension, diabetes mellitus, h/o tuberculosis, asthma, COPD, HIV
6. or HbsAg or HCV positive, alcoholic, smoker)
7. Duration of hospital stay (days)
8. Ease of wound dressing: frequency, amount of exudate removed, patient compliance and
9. comfort
10. Time taken to achieve wound healing either by secondary intention or delayed primary
11. closure.
12. Mortality, incidence and types of complications

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analysed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

RESULT

Table 1: Demographic Profile of Study Population

Variable	Group A (NPWT)	Group B (Conventional)	Total
Male	29 (64.44%)	27 (60.00%)	56 (62.22%)
Female	16 (35.56%)	18 (40.00%)	34 (37.78%)
Mean age (years)	37.93 ± 13.73	—	—
≤30 years	15 (33.33%)	19 (42.22%)	34 (37.78%)

Table 2: Comorbidities

Comorbidity	Group A (NPWT)	Group B (Conventional)	Total
Any comorbidity	28 (62.22%)	31 (68.89%)	59 (65.56%)
Diabetes Mellitus	6 (13.33%)	7 (15.56%)	13 (14.44%)
Hypertension	7 (15.56%)	8 (17.78%)	15 (16.67%)
Smoking	7 (15.56%)	9 (20.00%)	16 (17.78%)
Alcoholism	11 (24.44%)	12 (26.67%)	23 (25.56%)

Table 3: Etiology and Type of Open Abdomen (n=90)

Variable	Group A	Group B	Total
Planned OA	37 (41.11%)	—	37 (41.11%)

Unplanned OA	53 (58.89%)	—	53 (58.89%)
Ileal perforation	5	5	10 (11.11%)
Liver abscess rupture	6	5	11 (12.22%)
Duodenal perforation	4	3	7 (7.78%)
Gross contamination	16	5	21 (23.33%)
Fascial cut-through	0	24	24 (26.67%)
Wound tension closure	10	10	20 (22.22%)

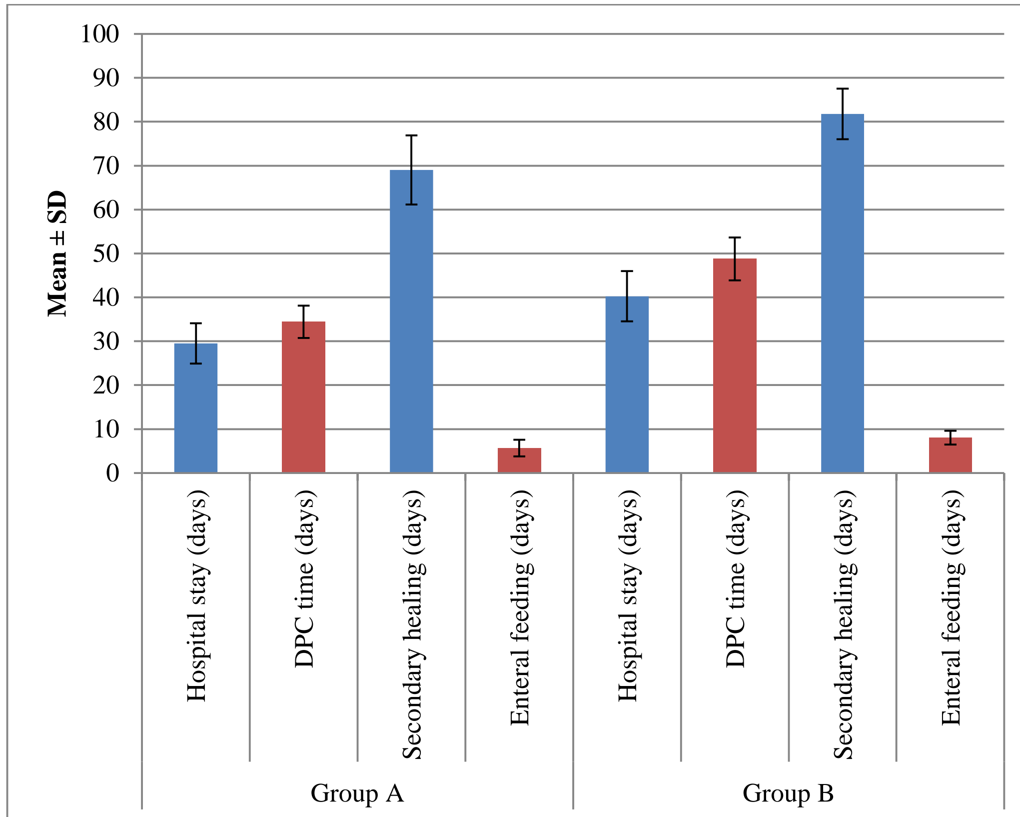

Figure 1: Recovery Outcomes

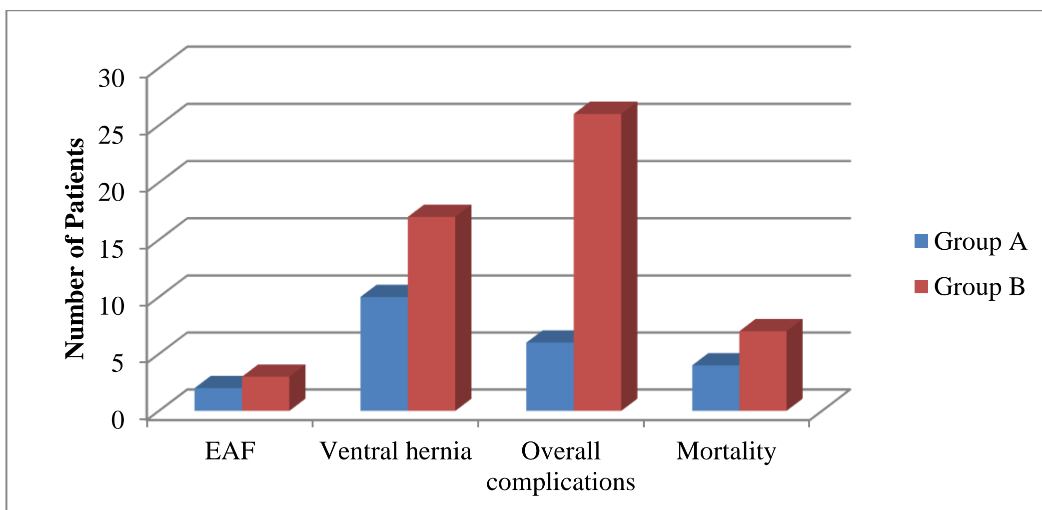

Figure. 2: Complications and Mortality (n=90)

Group A (NPWT) included 45 patients, of whom 29 were males (64.44%) and 16 were females (35.56%). The mean age was 37.93 ± 13.73 years, with 15 patients (33.33%) aged ≤30 years. Group B (Conventional) also included 45 patients, with 27 males (60.00%) and 18 females (40.00%), and 19

patients (42.22%) aged ≤30 years. Both groups were comparable in baseline demographic characteristics. Group A (NPWT) had 28 patients (62.22%) with comorbidities, including diabetes mellitus in 6 (13.33%), hypertension in 7 (15.56%), smoking in 7 (15.56%), and alcoholism in 11 (24.44%). Group B (Conventional) had 31 patients (68.89%) with comorbidities, including diabetes mellitus in 7 (15.56%), hypertension in 8 (17.78%), smoking in 9 (20.00%), and alcoholism in 12 (26.67%). Both groups were comparable in the distribution of comorbid conditions. A total of 37 patients (41.11%) had planned open abdomen, while 53 patients (58.89%) developed unplanned open abdomen. The common causes included ileal perforation in 10 patients (11.11%), liver abscess rupture in 11 (12.22%), and duodenal perforation in 7 (7.78%). Gross intraoperative contamination was seen in 21 patients (23.33%), fascial cut-through in 24 (26.67%), and wound closure under tension in 20 (22.22%). These etiological factors were distributed across both study groups. Group A showed significantly better recovery outcomes compared to Group B. The mean duration of hospital stay was 29.51 ± 4.57 days in Group A versus 40.25 ± 5.74 days in Group B ($p < 0.0001$). The time taken for delayed primary closure was 34.43 ± 3.69 days in Group A compared to 48.75 ± 4.85 days in Group B ($p < 0.0001$). The duration for secondary healing was also shorter in Group A (69.0 ± 7.87 days) than Group B (81.78 ± 5.78 days) ($p < 0.0001$). Similarly, resumption of enteral feeding occurred earlier in Group A (5.65 ± 1.89 days) compared to Group B (8.03 ± 1.59 days), which was statistically significant ($p < 0.0001$). Group A had 2 patients (4.44%) with entero-atmospheric fistula (EAF), while Group B had 3 patients (6.67%). Ventral hernia occurred in 10 patients (34.28%) in Group A compared to 17 patients (58.06%) in Group B ($p = 0.03$). Overall complications were seen in 6 patients (16.22%) in Group A and 26 patients (49.06%) in Group B ($p = 0.001$). Mortality was observed in 4 patients (8.89%) in Group A and 7 patients (15.56%) in Group B, which was not statistically significant ($p = 0.334$).

DISCUSSION

The present study demonstrated that Negative Pressure Wound Therapy (NPWT) provides superior clinical outcomes compared to conventional primary laparostomy in the management of open abdomen (OA). Both groups were comparable in terms of demographic characteristics, comorbidities, and etiological factors, thereby allowing reliable assessment of treatment outcomes. Carlson GL et al. [9] emphasized that NPWT facilitates earlier fascial closure and improves abdominal wall management in OA patients, findings that correlate with the significantly reduced hospital stay and earlier delayed primary closure observed in Group A of the present study. Similarly, Willms AG et al. [10] identified NPWT as an independent factor associated with improved fascial closure rates following open abdomen treatment, supporting the enhanced wound healing outcomes observed in the NPWT group. Cirocchi R et al. [11], in a systematic review and meta-analysis, reported that NPWT improves fascial closure rates and reduces complications compared to conventional temporary abdominal closure methods, which is consistent with the significantly lower overall complication rate and reduced ventral hernia incidence in the present study. Likewise, Szmyt K et al. [12] demonstrated superior healing efficiency and improved abdominal closure outcomes with NPWT compared to standard methods, findings reflected in the significantly shorter duration of secondary healing and earlier resumption of enteral feeding in Group A. In patients with severe abdominal sepsis, Sibaja P et al. [13] highlighted that NPWT with instillation improves wound control and decreases contamination burden, supporting the role of NPWT in complex abdominal conditions. Similarly, Wang Y et al. [14] reported improved fascial closure dynamics and reduced wound morbidity with NPWT systems following trauma laparotomy, findings comparable to the reduced complications and improved recovery outcomes observed in the present study. Furthermore, Wells CI et al. [15] demonstrated through a meta-analysis that prophylactic NPWT significantly reduces wound complications and surgical site infections in abdominal incisions. Tran BN et al. [16] also observed improved outcomes with closed-incision NPWT in high-risk abdominal wall reconstruction patients. Similarly, Gassman A et al. [17] reported reduced surgical site infection rates and positive outcomes with negative pressure therapy following large abdominal wall reconstruction. Overall, the findings of the present study are in agreement with the existing literature, which consistently supports NPWT as a superior temporary abdominal closure technique that improves wound healing, facilitates earlier closure, reduces complications, and enhances recovery outcomes compared to conventional open abdomen management.

CONCLUSION

This prospective study demonstrates that Negative Pressure Wound Therapy (NPWT) is more effective than conventional primary laparostomy in the management of open abdomen. Patients treated with NPWT showed significantly better clinical outcomes, including shorter hospital stay, earlier delayed primary closure, faster secondary wound healing, and earlier resumption of enteral feeding. NPWT also resulted in reduced wound dimensions

and improved fascial approximation compared to conventional technique. The incidence of complications such as ventral hernia and overall morbidity was significantly lower in the NPWT group, while the occurrence of entero-atmospheric fistula and mortality was comparable between the two groups. Although mortality differences were not statistically significant, the overall trend favored NPWT in terms of recovery and morbidity reduction. These findings suggest that NPWT is a safer and more effective temporary abdominal closure technique, offering improved wound management and enhanced postoperative recovery. Therefore, NPWT should be considered a preferred modality in appropriately selected patients with open abdomen.

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