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RESEARCH ARTICLE

Impact of Subcutaneous Negative-Pressure Suction Drainage on Postoperative Hospital Stay Following Emergency Exploratory Laparotomy: A Prospective Comparative Study

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ABSTRACT

Background: Surgical site infection (SSI) remains a common complication following emergency exploratory laparotomy and is associated with delayed wound healing, prolonged hospitalisation, increased healthcare costs, and greater postoperative morbidity. Subcutaneous negative-pressure suction drains are a simple intervention to reduce wound-related complications by eliminating dead space and preventing fluid accumulation.

Objectives: To evaluate the impact of subcutaneous negative-pressure suction drains on postoperative length of hospital stay among patients undergoing emergency exploratory laparotomy and to examine the relationship between SSI and hospitalisation duration.

Methods: A total of 100 patients undergoing emergency exploratory laparotomy were included and divided into two equal groups. Group A (n=50) underwent primary wound closure with placement of a subcutaneous negative-pressure suction drain, while Group B (n=50) underwent conventional wound closure without drainage. We compared hospital stay length between the groups and assessed the association between SSI and hospital stay.

Results: The mean age of participants was 43.56 ± 17.06 years, and 69% were male. Contaminated and dirty wounds accounted for 51% and 40% of cases, respectively. Patients in the drain group had a slightly shorter mean hospital stay (10.9 ± 4.2 days) than those in the non-drain group (11.3 ± 4.7 days). SSI occurred in 50.0% of patients in the drain group compared with 66.0% in the non-drain group. Patients who developed SSI experienced substantially longer hospitalisation (14.3 ± 4.7 days) compared with patients without SSI (7.0 ± 1.4 days).

Conclusion: Subcutaneous negative-pressure suction drainage was associated with a lower incidence of surgical site infection and a modest reduction in postoperative hospital stay following emergency exploratory laparotomy. Effective SSI prevention may support faster recovery, earlier discharge, and improved utilisation of healthcare resources.

Keywords: Emergency exploratory laparotomy; Surgical site infection; Negative-pressure suction drain; Hospital stay; Wound complications; Postoperative recovery.

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INTRODUCTION

Emergency exploratory laparotomy is one of the most frequently performed lifesaving surgical procedures for acute abdominal emergencies such as hollow viscus perforation, intestinal obstruction, peritonitis, abdominal trauma, and strangulated hernias. Despite advances in surgical techniques, perioperative care, and antimicrobial therapy, postoperative morbidity remains substantial in these patients. Surgical site infection (SSI), wound dehiscence, seroma formation, and delayed wound healing are among the most common complications following emergency abdominal surgery and often contribute to prolonged hospitalisation, increased healthcare expenditure, and reduced patient quality of life. In low- and middle-income countries, where emergency surgeries are commonly

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performed under challenging clinical conditions, reducing postoperative complications and shortening hospital stay remain important priorities.

Length of hospital stay is widely recognised as an important indicator of postoperative recovery, healthcare efficiency, and resource utilisation. A prolonged hospital stay is associated with increased risk of nosocomial infections, greater financial burden on patients and healthcare systems, delayed return to normal daily activities, and increased bed occupancy. Studies have shown that postoperative complications, particularly surgical site infections, significantly increase the duration of hospitalisation after abdominal surgery. Patients who develop wound-related complications frequently require prolonged antibiotic therapy, repeated wound dressings, secondary surgical procedures, and intensive monitoring, all of which contribute to extended inpatient care.[1,2]

Surgical site infections continue to represent a major challenge in abdominal surgery worldwide. According to international reports, SSI is among the most common healthcare-associated infections and is associated with significant postoperative morbidity. The burden is especially high in emergency laparotomy because patients often present with contaminated or dirty wounds, pre-existing infection, physiological derangements, malnutrition, and delayed presentation to healthcare facilities.[3,4] These factors not only increase the probability of infection but also adversely affect wound healing and recovery, thereby prolonging hospitalisation.

One strategy to reduce postoperative wound complications is using subcutaneous negative-pressure suction drains. These drains create a closed suction system within the subcutaneous tissue, continuously evacuating blood, serous fluid, and inflammatory exudates. By eliminating dead space and preventing fluid accumulation, negative-pressure drainage may reduce bacterial proliferation and lower the risk of wound infection.[5,6] Furthermore, the removal of excess fluid reduces tissue tension and edema, potentially promoting better wound healing and earlier recovery. The theoretical advantages of subcutaneous suction drainage have generated increasing interest, particularly in contaminated abdominal procedures where the risk of wound complications is high.

The relationship between wound complications and hospital stay is well documented. Postoperative seroma formation, wound infection, and delayed healing can necessitate prolonged treatment, frequent dressing changes, microbiological investigations, and additional therapeutic interventions. Seromas can act as a medium for bacterial growth, increasing the likelihood of infection and wound breakdown. Effective drainage of postoperative collections may therefore reduce infection rates, speed wound healing, and enable earlier hospital discharge.[7] Previous research has suggested that negative pressure wound management techniques may improve postoperative outcomes by reducing wound-related morbidity and facilitating recovery.[8]

Several patient-related factors also influence postoperative recovery and hospital stay. Comorbid conditions such as diabetes mellitus, hypertension, chronic kidney disease, and cardiovascular disorders have been associated with impaired wound healing and increased susceptibility to infection.[9] Similarly, nutritional deficiencies, particularly hypoalbuminemia, adversely affect tissue repair mechanisms and immune function, leading to delayed recovery and prolonged hospitalisation. Elevated inflammatory markers, including total leukocyte count (TLC), may indicate underlying infection or systemic inflammatory response, both of which can negatively impact postoperative outcomes.[10,11] Consequently, hospital stay duration after emergency laparotomy depends on a complex interaction among patient characteristics, disease severity, wound status, and postoperative management strategies.

From an economic perspective, prolonged hospitalisation places considerable strain on healthcare systems, particularly in resource-constrained settings. Extended inpatient care increases spending on medications, nursing care, investigations, and hospital resources while limiting bed availability for other patients requiring surgical treatment. Recent studies have reported that surgical site infections and postoperative wound complications contribute substantially to healthcare costs and significantly extend hospital stay following abdominal surgery.[12] Therefore, interventions capable of accelerating recovery and reducing hospitalisation have important clinical and economic implications.

Although several studies have investigated the role of negative pressure wound therapy and subcutaneous suction drains in preventing surgical site infections, evidence on their effect on hospital stay remains limited, particularly in patients undergoing emergency exploratory laparotomy in northeastern India. Understanding whether subcutaneous negative pressure suction drains can shorten hospitalisation may help surgeons optimise postoperative management and improve resource utilisation in tertiary care hospitals.

Therefore, this study evaluated the impact of subcutaneous negative pressure suction drain placement on length of hospital stay among patients undergoing

emergency exploratory laparotomy and explored the relationship between postoperative wound outcomes and hospitalisation duration. The findings may provide valuable evidence on the effectiveness of this simple, cost-effective intervention in improving postoperative recovery in high-risk abdominal surgical patients.

MATERIALS AND METHODS

Study Design and Setting

This prospective hospital-based comparative observational study was conducted in the Department of General Surgery, Agartala Government Medical College and G.B.P. Hospital, Tripura, India, over a period of 18 months from 2023 to 2024. The study aimed to evaluate the impact of subcutaneous negative-pressure suction drain placement on length of hospital stay among patients undergoing emergency exploratory laparotomy.

Study Population

The study included patients who underwent emergency exploratory laparotomy for various acute abdominal conditions, including hollow viscus perforation, intestinal obstruction, peritonitis, abdominal trauma, and other emergency surgical indications. A total of 100 eligible patients were enrolled consecutively during the study period and were divided into two equal groups based on the use of subcutaneous negative pressure suction drainage.

Study Groups

- **Group A (Drain Group):** Fifty patients underwent primary wound closure with placement of a subcutaneous negative pressure suction drain.
- **Group B (Non-Drain Group):** Fifty patients underwent conventional wound closure without placement of a subcutaneous drain.

Inclusion Criteria

- Patients aged 14 to 75 years undergoing emergency exploratory laparotomy.
- Patients willing to participate and provide informed consent.
- Patients available for postoperative follow-up until hospital discharge.

Exclusion Criteria

- Patients or attendants unwilling to provide informed consent.
- Patients with known malignancy.
- Immunocompromised patients, including those with HIV infection, long-term steroid therapy, or chemotherapy.
- Patients with accidental postoperative drain removal.
- Patients who were discharged on request or left against medical advice before completion of proper postoperative care.

Data Collection Procedure

After obtaining written informed consent, demographic and clinical data were recorded using a predesigned case record form. Information collected included age, sex, diagnosis, comorbidities, laboratory parameters, and operative findings. Baseline investigations such as complete blood count, random blood sugar, renal and liver function tests, serum electrolytes, electrocardiography, chest radiography, abdominal radiography, and ultrasonography were documented.

Intraoperative findings including wound contamination status, incision characteristics, and peritoneal contamination were recorded. In patients receiving subcutaneous suction drains, the quantity and characteristics of drain output were monitored daily. Drain removal was performed when the output was less than 10 mL for two consecutive days.

Outcome Measure

The primary outcome variable was length of hospital stay, defined as the total number of days from the date of surgery to the date of discharge. We compared hospital stay duration between patients managed with subcutaneous negative pressure suction drains and those managed without drains. Secondary analyses examined the association between surgical site infection and hospitalisation duration.

Postoperative Follow-up

All patients were monitored daily during their hospital stay. Wound assessment was performed using the Southampton Wound Grading System (Table 1). Surgical site infection was diagnosed based on clinical findings and microbiological evaluation whenever indicated. Patients developing wound complications were managed according to standard institutional protocols.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 24.0. Continuous variables were reported as mean ± standard deviation, and categorical variables as frequencies and percentages. Comparison of mean hospital stay between the two study groups was performed using the Student's t-test. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact

Table 1: Southampton Grading System for Assessment of Surgical Wound Outcomes

Grade	*Assessment criteria*
0	Normal wound healing without complications
I	Mild changes: bruising (Ia-Ib) or mild erythema (Ic)
II	Erythema and inflammation around wound or sutures (IIa-IId)
III	Clear or haemoserous discharge from wound (IIIa-IIId)
IV	Purulent discharge from wound (IVa-IVb)
V	Deep or severe wound infection with tissue breakdown or hematoma requiring aspiration

test where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Agartala Government Medical College (Ref. No. F.4 (6-13)/AGMC/Medical Education/IEC Approval/2022/24352). Written informed consent was obtained from all participants before enrolment, and confidentiality of patient information was maintained throughout the study.

RESULTS

Baseline Characteristics of the Study Population

The study included 100 patients undergoing emergency exploratory laparotomy. The mean age was 43.56 ± 17.06 years. The largest proportion of patients belonged to the 40-49 years age group (23%), followed by the 60-69 years (20%) and 30-39 years (18%) age groups. Male patients constituted 69% of the study population, whereas females accounted for 31%. In terms of wound classification, contaminated wounds were most common (51%), followed by dirty wounds (40%), while clean-contaminated wounds accounted for only 9% of cases. These findings indicate that the study population predominantly consisted of middle-aged male patients presenting with contaminated or dirty abdominal wounds (Table 1).

Table 2 compares hospital stay duration between patients who received a subcutaneous negative-pressure suction drain and those who did not. The findings showed that patients in the drain group (Group A) had a slightly shorter mean hospital stay (10.9 ± 4.2 days) than those in the non-drain group (Group B), whose mean hospital stay was 11.3 ± 4.7 days. The overall mean duration of hospital stay for all 100 participants was 11.1 ± 4.4 days. These findings suggest that using a subcutaneous negative-pressure suction drain may modestly reduce the length of postoperative hospitalisation following emergency exploratory laparotomy.

Table 3 shows the relationship between SSI and hospital stay duration among patients undergoing emergency exploratory laparotomy. Patients who developed SSI (n = 58) experienced a substantially longer hospital stay, with a mean duration of 14.3 ± 4.7 days, compared with patients who did not develop SSI (n = 42), whose mean hospital stay was 7.0 ± 1.4 days. The overall mean hospital stay for the study population was 11.2 ± 5.0 days. These findings indicate that the occurrence of SSI was associated with a marked increase in the duration of hospitalisation, nearly doubling the average length of stay.

Table 4 presents the distribution of SSI and mean hospital stay duration by drain type. Among patients who received a subcutaneous negative-pressure suction drain (n = 50), 25 patients (50.0%) developed SSI, while 25 patients

Table 2: Baseline Characteristics of Study Participants (N = 100)

Variable	*Category*	*Frequency (n)*	*Percentage (%)*
Age Group (years)	14–19	11	11.0
	20–29	12	12.0
	30–39	19	19.0
	40–49	23	23.0
	50–59	13	13.0
	60–69	20	20.0
	70–75	2	2.0
	Total	100	100
Sex	Male	69	69.0
	Female	31	31.0
Wound Type	Contaminated	51	51.0
	Dirty	40	40.0
	Clean-contaminated	9	9.0
Age (Mean ± SD)	43.56 ± 17.06 years	-	-

Table 3: Comparison of Hospital Stay Duration According to Drain Usage

Drain status	*Number of patients (n)*	*Mean hospital stay (Days)*	*SD*
Group A (With Subcutaneous Negative Pressure Suction Drain)	50	10.9	4.2
Group B (Without Drain)	50	11.3	4.7
Total	100	11.1	4.4

(50.0%) remained free of SSI. In contrast, among patients who did not receive a drain (n = 50), 33 (66.0%) developed SSI, and 17 (34.0%) did not. The mean hospital stay was 10.9 days in the drain group compared with 11.3 days in the non-drain group. These findings indicate that patients managed with subcutaneous negative-pressure suction drains had a lower SSI rate and a slightly shorter hospital stay than those managed without drains.

Table 4: Relationship Between Surgical Site Infection (SSI) and Duration of Hospital Stay

SSI status	*Number of patients (n)*	*Mean hospital stay (Days)*	*SD*
SSI Present	58	14.3	4.7
SSI Absent	42	7.0	1.4
Total	100	11.2	5.0

DISCUSSION

SSI remains one of the most frequent complications following abdominal surgery and continues to contribute substantially to postoperative morbidity, delayed recovery, and prolonged hospitalisation. A recent systematic review by Amirah et al. highlighted wound contamination, emergency procedures, patient comorbidities, and inadequate wound healing as major factors contributing to SSI. Since emergency exploratory laparotomy is commonly performed in patients presenting with peritonitis, perforation, intestinal obstruction, and other contaminated intra-abdominal conditions, the risk of postoperative wound complications remains particularly high.[13]

The findings of the present study are consistent with previous literature describing the burden of SSI following gastrointestinal and abdominal surgeries. The GlobalSurg Collaborative reported that surgical site infections are common after gastrointestinal surgery and are associated with adverse postoperative outcomes across countries of different income levels.[3] Similarly, Marzoug, Anees and Malik demonstrated that abdominal surgical procedures carry a significant risk of SSI, especially in emergency settings where wound contamination and patient-related risk factors are frequently present.[14] In the present study, contaminated and dirty wounds constituted 91% of all cases, further emphasising the high-risk nature of the study population.

This study aimed to evaluate the effect of subcutaneous negative-pressure suction drains on postoperative hospital stay following emergency exploratory laparotomy. Patients managed with subcutaneous suction drains had a slightly shorter mean hospital stay (10.9 ± 4.2 days) than those with conventional wound closure without drainage (11.3 ± 4.7 days). Although the difference was modest, the findings suggest that subcutaneous drainage may improve postoperative recovery.

One possible explanation for this observation is the lower incidence of SSI among patients receiving drains. In the present study, 50.0% of patients in the drain group developed SSI compared with 66.0% in the non-drain group. Isozaki reported that closed suction drainage can effectively reduce the risk of incisional SSI by preventing fluid accumulation within the subcutaneous tissue.[15] Likewise, Ohara et al. demonstrated that subcutaneous drainage techniques that reduce dead space significantly improve wound healing and decrease superficial surgical-site infections.[6] These studies support the hypothesis that continuous evacuation of blood, serous fluid, and inflammatory exudates may limit bacterial proliferation and promote favourable wound healing conditions.

Table 5: Hospital Stay According to Drain Usage and SSI Occurrence

Group	*SSI present n (%)*	*SSI absent n (%)*	*Mean hospital stay (Days)*
With Drain (n=50)	25 (50.0)	25 (50.0)	10.9
Without Drain (n=50)	33 (66.0)	17 (34.0)	11.3

Another important finding of the present study was the strong relationship between SSI and duration of hospitalisation. Patients who developed SSI had a mean hospital stay of 14.3 ± 4.7 days, whereas patients without SSI stayed for only 7.0 ± 1.4 days. This substantial difference highlights the clinical impact of wound infection on postoperative recovery. According to Badia et al., preventing SSI remains critical to improving surgical outcomes and reducing postoperative complications.[16] Monahan et al. further reported that SSI substantially increases healthcare expenditure and resource utilisation due to prolonged hospitalisation, additional treatment requirements, and intensive wound care.[2]

The observed reduction in hospital stay among patients with drains may therefore indirectly reflect fewer wound complications. Postoperative seroma formation has been recognised as a major factor delaying wound healing and increasing the risk of infection. Zabaglo, Leslie and Sharman noted that seromas provide a favourable environment for bacterial growth and often require additional interventions that can lengthen recovery time. Effective drainage of postoperative collections may therefore facilitate earlier wound healing and reduce the need for prolonged inpatient management.[17]

Negative-pressure wound management has also shown benefit in contaminated emergency abdominal surgeries. Lakhani et al. found that negative-pressure-assisted wound management was associated with fewer wound complications and improved postoperative outcomes than conventional approaches.[18] Although the present study assessed subcutaneous suction drains rather than full negative-pressure wound therapy systems, both approaches aim to minimise fluid accumulation and reduce the likelihood of SSI.

Patient-related factors may also have influenced postoperative outcomes in the present study. Martin et al. identified diabetes mellitus, emergency surgical status, and wound contamination as significant risk factors for SSI.[19] Furthermore, Haloho, Nurnaningsih and Paryanto reported that poor nutritional status, particularly hypoalbuminemia, is associated with increased abdominal wound-related complications after emergency laparotomy.[20] These factors may partly explain the variability in postoperative recovery observed among the study participants.

Similarly, Healy et al. demonstrated that postoperative infections and underlying clinical conditions are important determinants of prolonged hospital stay among surgical patients.[21] Therefore, the duration of hospitalisation following emergency exploratory laparotomy is likely influenced by a combination of wound status, patient characteristics, disease severity, and postoperative management strategies.

Overall, this study suggests that subcutaneous negative-pressure suction drains may reduce wound-related complications and modestly shorten hospital stay among patients undergoing emergency exploratory laparotomy. The findings support the use of this simple and cost-effective intervention as part of comprehensive postoperative wound management strategies, particularly in high-risk patients with contaminated or dirty abdominal wounds.

Study Limitations

- The study was conducted at a single tertiary care centre, which may limit the generalizability of the findings to other healthcare settings.
- The sample size was relatively small, comprising only 100 participants.
- Patients were followed only until hospital discharge, and long-term postoperative outcomes were not assessed.
- Potential confounding factors such as nutritional status, duration of surgery, severity of peritoneal contamination, antibiotic compliance, and socioeconomic status were not analysed separately.
- The observational design limits the ability to establish a definitive causal relationship between drain placement and postoperative outcomes.
- Some patients were discharged on request or left against medical advice before completion of proper postoperative care, which may have resulted in incomplete outcome assessment and potential follow-up bias.

CONCLUSION

The present study demonstrated that subcutaneous negative-pressure suction drains after emergency exploratory laparotomy were associated with a lower rate of surgical site infection and a modest reduction in postoperative hospital stay. Surgical site infection was a major determinant of prolonged hospitalisation, with affected patients experiencing nearly twice the duration of hospital stay compared with those without infection. Although the reduction in hospital stay was relatively small, the findings suggest that subcutaneous negative-pressure suction drainage may serve as a simple, cost-effective adjunct to postoperative wound management. Its use may be particularly beneficial in patients with contaminated or dirty abdominal wounds, where the risk of wound-related complications is high. Further multicentre studies with

larger sample sizes are recommended to confirm these findings and establish evidence-based recommendations for routine clinical practice.

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