Section: General Surgery

Original Research Article

A COMPARATIVE STUDY ON THE ROLE OF APPLICATION OF CORRUGATED SHEET DRAIN VS NON-APPLICATION OF CORRUGATED SHEET DRAIN IN SUBCUTANEOUS TISSUE SPACE IN CASES OF EMERGENCY ABDOMINAL SURGERY

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Received *: 05/06/2026*
Received in revised form *: 07/08/2026*
Accepted *: 19/08/2026*

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DOI: 10.70034/ijmedph.2026.3.723

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 4678-4682

ABSTRACT

Background: Emergency abdominal surgery often presents significant challenges due to the urgency and complexity of the conditions being treated. Postoperative complications such as seromas, hematomas, and wound infections are common concerns that can adversely affect patient recovery and outcomes. Effective management of the subcutaneous tissue space is crucial in minimizing these complications and enhancing patient recovery. The aim and objective is to evaluate the role of corrugated sheet drains in postoperative outcomes, wound healing, infection prevention, and long-term management of abdominal surgical site complications.

Materials and Methods: The present study was a Comparative and Prospective study. This Study was conducted from 18 months, Department of General Surgery at Calcutta National Medical College and Hospital for Emergency abdominal open surgeries from surgical emergency. A total of 100 eligible patients were included in the study and were divided into two groups of 50 patients each: Group A (corrugated sheet drain placed intraoperatively) and Group B (no corrugated sheet drain placed intraoperatively). Corrugated sheet drains mainly made of PVC supplied by West Bengal Government were only used for subcutaneous placement.

Results: The study demonstrated significantly higher postoperative complications in Group-B, including seroma formation (58% vs 24%), pus formation (30% vs 2%), longer hospital stay(12.16±2.91 vs 8.52±1.49 days), increased postoperative pain (5.16±1.06 vs 3.00±0.81), and delayed wound healing (44.50±10.28 vs 32.40±3.65 days) compared with Group-A (all $p<0.0001$).

Conclusion: The study found that corrugated sheet drains reduced postoperative complications, including seroma, hematoma, and wound infections. Group-B showed significantly higher seroma rates, longer hospital stays, and greater postoperative pain compared with Group-A. Wound healing duration was also increased in Group-B, though without statistical significance.

Keywords: Corrugated sheet drain, Emergency abdominal surgery, Subcutaneous tissue space, Postoperative complications, Seroma, Hematoma and Wound infection.

INTRODUCTION

This prospective cohort study evaluates the use of corrugated sheet drains in emergency abdominal surgeries, particularly in clean-contaminated and contaminated cases, and assesses their role in improving wound healing outcomes. Although abdominal surgeries have been performed since

ancient times, with recent advancements shifting surgical practice towards laparoscopic and minimally invasive approaches, the importance of subcutaneous tissue healing in open abdominal surgeries remains significant. Therefore, this study aimed to perform a comparative analysis of corrugated sheet drain usage in emergency abdominal surgeries and evaluate postoperative outcomes, especially regarding wound healing. Postoperative wound healing and associated complications remain major concerns as they contribute to increased patient morbidity. Wound management continues to be a fundamental component of surgical practice, while wound-related infections and their management remain challenging.[1] Surgical site infections (SSIs) represent one of the most important postoperative complications. SSIs are defined as infections occurring when microorganisms invade tissues within 30 days of surgery involving superficial layers and within 30 to 90 days for deep layers.[2] SSIs are classified into two major categories: incisional and organ/space infections. Incisional SSIs are limited to the surgical site and are further divided into superficial and deep SSIs. Superficial SSIs involve the skin and superficial fascia, whereas deep SSIs involve infection of fascial and muscular layers. Organ/space SSIs affect tissues beneath the fascial layer involved in the surgical procedure within 30 to 90 days after surgery. The global incidence of SSI ranges between 0.5 and 15%, whereas in India, it has been reported to be significantly higher, ranging from 23 to 38%. The occurrence of SSI after surgery depends on factors such as microbial virulence and inoculum size.[3] The risk of infection increases due to the presence of dead space, hematoma, and devitalized tissue, which may result from inadequate surgical techniques. Similar risks are associated with foreign materials such as drains and sutures. Patients with high BMI, a history of alcoholism, chronic heart disease, and diabetes are considered major risk factors for SSI development.[4] These conditions contribute to reduced immune function and delayed wound healing. The nature of the wound and type of surgery also influence SSI development. Contaminated wounds undergoing emergency procedures, such as emergency abdominal laparotomy, have a higher risk of SSI compared with elective surgeries performed for clean conditions, such as cholecystectomy. This increased risk is attributed to the presence of microorganisms in contaminated wounds, which may enter the bloodstream and contribute to infection. SSIs commonly present with symptoms such as pain, erythema, fever, pus formation, wound discharge, and dehiscence. Various preventive strategies have been adopted, including proper hand hygiene, hair removal, chlorhexidine preparation, and antibiotic prophylaxis before surgery.[5] The placement of subcutaneous drains in surgical wounds after surgery has shown promising results, particularly in emergency laparotomy cases. The principle behind drain placement is the removal of accumulated fluid and debris along with reduction of dead space within the subcutaneous plane, thereby decreasing the risk of infection and wound-related complications. Drain output is monitored regularly, and drains placed beneath flaps may help prevent seroma formation. Removal of the drain is performed under sterile conditions followed by pressure dressing. In cases of recurrent seroma, aspiration may be required. If seroma reaccumulates after two aspirations, evacuation by reopening the incision and packing the wound with saline gauze may be performed to allow secondary healing. Hematoma prevention involves correction of coagulation abnormalities.[6] For high-risk patients, interrupted sutures or synthetic mesh may be considered safer options. These approaches, along with moist surgical gauze, iodophor dressing, and continuous suctioning, have demonstrated beneficial outcomes. Wounds may achieve closure within 7 to 10 days; however, if closure is not possible, the wound is allowed to undergo granulation followed by closure using skin grafting. Some studies have reported that the use of subcutaneous catheters with antibiotic coverage and saline irrigation is effective mainly in dirty wounds.[7]

MATERIALS AND METHODS

Study design: Comparative and Prospective study
Place of study: Patients getting admitted in Calcutta National Medical College and Hospital for Emergency abdominal open surgeries from surgical emergency.
Period of study: 18 months
Study Population: The study population consisted of 100 patients undergoing emergency open abdominal surgeries admitted through the Surgical Emergency Department of Calcutta National Medical College and Hospital during the 18-month study period. Patients fulfilling the eligibility criteria were prospectively followed to assess postoperative outcomes and compare relevant surgical parameters. The participants were equally allocated into two groups: Group A comprised patients in whom a corrugated sheet drain was placed intraoperatively, while Group B comprised patients in whom no corrugated sheet drain was placed intraoperatively. Each group included 50 patients, and postoperative outcomes were compared between the two groups.
Sample size: 100 Patients (Each group included 50 patients)
Inclusion Criteria:

- Patients getting admitted in Department of General surgery through surgical outpatient departments and surgical emergency.
- Patients giving consent for abdominal surgeries (emergency)
- Patients willing to participate in the study.
- Serologically negative patients who are immunologically competent and not under Chemotherapy / Radiotherapy / Immunotherapy/ Corticosteroid use

- Patients aging between 12 years to 70 years
- Females who are confirmed UPT negative

Exclusion criteria:

- Patients not giving consent for Abdominal Surgeries (Emergency)
- Patients not willing to participate in the study
- Sero-positive and immune compromised patient and patients undergoing Chemotherapy /Radiotherapy /Immunotherapy / Corticosteroid use
- Patients aging below 12 and over 70 years
- Females who are confirmed UPT positive or requiring any other gynaecological or obstetrical intervention simultaneously.
- Any case of complicated (obstructed / strangulated) Incisional hernia in the abdomen. The criteria into two - Patient of abdominal surgeries in who corrugated sheet drains were inserted in the subcutaneous tissue.

Study Variable:

- Demographic variables: Age, sex, residence, and body mass index (BMI).
- Clinical variables: Indication for emergency abdominal surgery, comorbidities, and wound contamination status.
- Exposure variable: Application or non-application of corrugated sheet drain in the subcutaneous tissue space.
- Postoperative outcome variables: Seroma formation, pus formation, wound infection, duration of hospital stay, postoperative pain score, and surgical wound healing time.
- Functional outcome variable: Time to return to normal daily activities (days).

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.

RESULTS

Table 1: Demographic Characteristics of Study Participants

Variable	Category	Group-A n (%)	Group-B n (%)	p-value
Age Group (Years)	≤30	4 (8.0)	2 (4.0)	0.1582
	31–40	15 (30.0)	13 (26.0)	
	41–50	15 (30.0)	8 (16.0)	
	51–60	11 (22.0)	22 (44.0)	
	61–70	5 (10.0)	5 (10.0)	
Mean Age (Years)		45.30 ± 10.71	49.06 ± 10.58	0.0804
Sex	Female	30 (60.0)	30 (60.0)	1
	Male	20 (40.0)	20 (40.0)	
Residence	Rural	30 (60.0)	30 (60.0)	1
	Urban	20 (40.0)	20 (40.0)	

Table 2: Clinical Characteristics of Study Participants

Clinical Variable	Category	Group-A n (%)	Group-B n (%)	p-value
Clinical Variable-1	Present	9 (18.0)	11 (22.0)	0.784
	Absent	41 (82.0)	39 (78.0)	
Clinical Variable-2	Present	7 (14.0)	11 (22.0)	0.9781
	Absent	43 (86.0)	39 (78.0)	

Table 3: Baseline Clinical and Demographic Comparison between Groups

Parameter	Group-A (n=50)	Group-B (n=50)	p-value
Age (Years) Mean ± SD	45.30 ± 10.71	49.06 ± 10.58	0.0804
BMI Mean ± SD	26.46 ± 3.18	25.86 ± 3.14	0.346
Female Sex	30 (60.0%)	30 (60.0%)	1
Rural Residence	30 (60.0%)	30 (60.0%)	1

Table 4: Postoperative Complications According to Study Groups

Postoperative Outcome	Group-A n (%)	Group-B n (%)	p-value
Seroma Formation	12 (24.0)	38 (76.0)	0.0005
No Seroma	38 (76.0)	12 (24.0)	
Pus Formation	1 (2.0)	15 (30.0)	<0.0001
No Pus Formation	49 (98.0)	35 (70.0)	
Wound Infection	1 (2.0)	9 (18.0)	0.0076
No Infection	49 (98.0)	41 (82.0)	

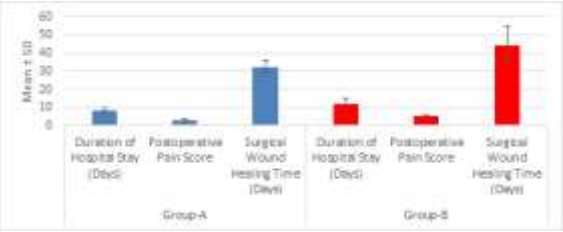

Figure 1: Comparison of Postoperative Recovery Outcomes

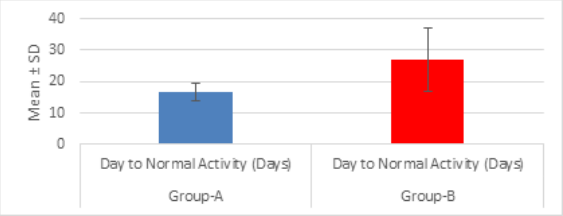

Figure 2: Functional Recovery Outcome between Study Groups

In Group-A, 4 patients (8.0%) were aged ≤30 years, 15 patients (30.0%) were 31–40 years, 15 patients (30.0%) were 41–50 years, 11 patients (22.0%) were 51–60 years, and 5 patients (10.0%) were 61–70 years of age. In Group-B, 2 patients (4.0%) were aged ≤30 years, 13 patients (26.0%) were 31–40 years, 8 patients (16.0%) were 41–50 years, 22 patients (44.0%) were 51–60 years, and 5 patients (10.0%) were 61–70 years of age. The distribution of age groups between the two groups was not statistically significant (p=0.1582). The mean age was 45.30 ± 10.71 years in Group-A and 49.06 ± 10.58 years in Group-B, with no statistically significant difference (p=0.0804). Regarding sex, 30 patients (60.0%) were females and 20 patients (40.0%) were males in both Group-A and Group-B, and the difference was not statistically significant (p=1.0000). Similarly, 30 patients (60.0%) in each group belonged to rural areas, while 20 patients (40.0%) belonged to urban areas. The distribution of residence between the two groups was also not statistically significant (p=1.0000). [Table 1]

In Group-A, 9 patients (18.0%) had Clinical Variable-1, while 41 patients (82.0%) did not. In Group-B, 11 patients (22.0%) had Clinical Variable-1 and 39 patients (78.0%) did not. Similarly, Clinical Variable-2 was present in 7 patients (14.0%) and absent in 43 patients (86.0%) in Group-A, whereas in Group-B, 11 patients (22.0%) had Clinical Variable-2 and 39 patients (78.0%) did not. The distribution of Clinical Variable-1 (p=0.7840) and Clinical Variable-2 (p=0.9781) between the two groups was not statistically significant, indicating that both groups were comparable with respect to these baseline clinical characteristics. [Table 2]

The mean age of patients was 45.30 ± 10.71 years in Group-A and 49.06 ± 10.58 years in Group-B, with no statistically significant difference between the groups (p=0.0804). The mean BMI was 26.46 ± 3.18 kg/m² in Group-A and 25.86 ± 3.14 kg/m² in Group-B, which was also not statistically significant (p=0.3460). In both groups, 30 patients (60.0%) were females and 20 patients (40.0%) were males (p=1.0000). Similarly, 30 patients (60.0%) in each group belonged to rural areas, while 20 patients (40.0%) belonged to urban areas, with no statistically significant difference between the groups (p=1.0000). [Table 3]

In Group-A, 12 patients (24.0%) developed seroma, whereas 38 patients (76.0%) did not. In Group-B, 38 patients (76.0%) developed seroma and 12 patients (24.0%) did not. The incidence of seroma formation was significantly higher in Group-B than in Group-A (p=0.0005). Pus formation was observed in 1 patient (2.0%) in Group-A and 15 patients (30.0%) in Group-B, while no pus formation was noted in 49 patients (98.0%) and 35 patients (70.0%), respectively. The difference in pus formation between the groups was statistically significant (p<0.0001). Similarly, wound infection occurred in 1 patient (2.0%) in Group-A and 9 patients (18.0%) in Group-B, whereas no wound infection was observed in 49 patients (98.0%) and 41 patients (82.0%), respectively. The incidence of wound infection was significantly higher in Group-B compared with Group-A (p=0.0076). [Table 4]

The mean duration of hospital stay was 8.52 ± 1.49 days in Group-A and 12.16 ± 2.91 days in Group-B. The mean postoperative pain score was 3.00 ± 0.81 in Group-A compared with 5.16 ± 1.06 in Group-B. The mean surgical wound healing time was 32.40 ± 3.65 days in Group-A and 44.50 ± 10.28 days in Group-B. The duration of hospital stay, postoperative pain score, and surgical wound healing time were all significantly higher in Group-B than in Group-A (p<0.0001 for all comparisons). [Figure 1]

The mean time to return to normal activity was 16.64 ± 2.81 days in Group-A and 26.84 ± 10.16 days in Group-B. The minimum time to return to normal activity was 14 days in Group-A and 17 days in Group-B, while the maximum time was 34 days and 52 days, respectively. The mean duration to resume normal activity was significantly longer in Group-B compared with Group-A (p<0.0001). [Figure 2]

DISCUSSION

Willard FH et al,[8] described the anatomical importance of the thoracolumbar fascia in maintaining the structural integrity of the abdominal wall and facilitating postoperative wound healing. Akram J et al,[9] emphasized that comparable baseline patient characteristics are essential for valid evaluation of postoperative outcomes, while Gasser RF,[10] and Stokes RB et al,[11] highlighted the importance of abdominal wall anatomy and vascular supply in tissue viability and wound healing. In the present study, both groups were comparable at baseline with respect to age distribution, mean age (45.30 ± 10.71 vs. 49.06 ± 10.58 years; p=0.0804), BMI (26.46 ± 3.18 vs. 25.86 ± 3.14 kg/m²; p=0.3460), sex, residence, and baseline clinical characteristics (p>0.05 for all). Karthick R,[12]

reported that subcutaneous drainage significantly reduces postoperative wound complications following emergency laparotomy, while Strodtbeck F,[13] explained that prevention of fluid accumulation and infection promotes optimal wound healing. Honnegowda TM et al,[14] further demonstrated that effective angiogenesis accelerates tissue repair, and Craig RD et al,[15] emphasized that collagen biosynthesis is fundamental for normal wound healing. Priyadharshini A,[16] similarly reported lower incidences of seroma, wound infection, and delayed wound healing with prophylactic subcutaneous drains. Consistent with these findings, the present study demonstrated significantly lower rates of seroma formation (24.0% vs. 76.0%; p=0.0005), pus formation (2.0% vs. 30.0%; p<0.0001), and wound infection (2.0% vs. 18.0%; p=0.0076) in Group-A compared with Group-B. Ahmed Z et al,[17] reported that effective wound management shortens hospital stay and improves functional recovery, whereas Nathan C and Shiloh MU,[18] showed that reducing microbial proliferation and local inflammation decreases postoperative wound infection. Turina M et al,[19] further emphasized that minimizing postoperative inflammatory stress promotes faster recovery, while Bogardus C et al,[20] demonstrated that obesity adversely affects wound healing. In the present study, despite comparable BMI between the two groups, patients in Group-A had significantly shorter hospital stay (8.52 ± 1.49 vs. 12.16 ± 2.91 days; p<0.0001), lower postoperative pain score (3.00 ± 0.81 vs. 5.16 ± 1.06; p<0.0001), faster wound healing time (32.40 ± 3.65 vs. 44.50 ± 10.28 days; p<0.0001), and earlier return to normal activity (16.64 ± 2.81 vs. 26.84 ± 10.16 days; p<0.0001).

CONCLUSION

The present study concludes that application of a corrugated sheet drain in the subcutaneous tissue space during emergency abdominal surgery significantly improves postoperative outcomes. It reduces seroma formation, pus formation, wound infection, postoperative pain, and duration of hospital stay. Patients with drain application showed faster wound healing and earlier return to normal activity compared with those without drain placement. Therefore, corrugated sheet drain is a simple, effective, and useful technique for reducing wound complications and improving recovery after emergency abdominal surgery.

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