

Efficacy of Subcutaneous Closed Suction Drain in Reduction of The Post-Operative Surgical Site Infection in Tertiary Level Hospital in Salem

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ABSTRACT

Background: Surgical Site Infections (SSIs) are among the most common postoperative complications, particularly in emergency laparotomies, contributing to increased morbidity, prolonged hospital stays, and higher healthcare costs. The use of subcutaneous closed suction drains has been proposed as a preventive measure to reduce fluid accumulation, minimize bacterial proliferation, and improve overall wound healing. However, the effectiveness of this intervention remains a subject of debate.

Objective: This study aimed to evaluate whether the use of subcutaneous closed suction drains significantly reduces the incidence of SSIs in patients undergoing emergency laparotomy surgeries at a tertiary-level hospital in Salem.

Methods: A prospective comparative study was conducted among 100 patients undergoing emergency laparotomy. Participants were randomly assigned to two groups: the case group (n=50), in which a subcutaneous closed suction drain was placed before skin closure, and the control group (n=50), in which no drain was used. Patients aged <18 or >80 years, those with immunocompromised conditions (HIV, radiotherapy, chemotherapy, diabetes), and those undergoing repeat laparotomies were excluded. Data were collected on demographic characteristics, diagnosis, intraoperative contamination, surgical site infections, and postoperative outcomes. Statistical analysis was performed using SPSS software, with p-values < 0.05 considered statistically significant.

Results: The mean age of the study participants was 43.7 ± 17.09 years (range: 16–74 years), with a male predominance (60% males, 40% females). The incidence of Surgical Site Infections (SSI) was significantly lower in the subcutaneous drain group (12.5%) compared to the non-drain group (71.15%) ($p < 0.001$). The mean postoperative hospital stay was comparable between groups (11.85 ± 6.47 days vs. 11.46 ± 5.61 days; $p = 0.746$). Microbiological analysis revealed that patients with subcutaneous drains had a higher proportion of sterile cultures (93.75%) and a lower incidence of bacterial growth, including *Staphylococcus aureus* (4.16% vs. 34.61%), *Escherichia coli* (0% vs. 21.1%), and *Klebsiella* (2.08% vs. 17.3%) in comparison to the non-drain group.

Conclusion: The findings suggest that subcutaneous closed suction drains significantly reduce the incidence of SSIs in emergency laparotomies without prolonging hospital stay. This intervention also minimizes bacterial colonization, making it an effective strategy for reducing postoperative complications. Implementing routine use of subcutaneous drains in high-risk surgical cases may help improve patient outcomes and reduce healthcare burdens.

Keywords: Surgical Site Infection, Subcutaneous Suction Drain, Emergency Laparotomy, Postoperative Outcomes, Wound Healing, Infection Control, Hospital Stay, Bacterial Growth.

1. INTRODUCTION

Surgical Site Infections (SSIs) are one of the most common postoperative complications, contributing significantly to increased morbidity, prolonged hospital stays, and higher healthcare costs. According to the World Health Organization (WHO), SSIs account for approximately 11.8 per 100 surgical procedures in lower-middle-income countries, with rates varying from 1.2% to 23.6%. In India, the incidence is notably higher, ranging from 23% to 38%, making it a pressing concern in surgical practice [1]. SSIs arise when microbial pathogens, predominantly from the patient's endogenous flora, colonize the surgical site, leading to localized or systemic infections. The most frequently isolated organisms include *Staphylococcus aureus*, coagulase-negative staphylococci, *Enterococcus* species, and *Escherichia coli* [2]. The risk of developing an SSI depends on multiple factors, including patient-related conditions such as immunocompromised states, obesity, and diabetes, surgery-related factors such as prolonged operative time and intraoperative contamination, and environmental aspects like operating room sterility and infection control protocols [3].

Despite significant advancements in aseptic techniques and perioperative care, SSIs remain a persistent challenge, particularly in emergency surgeries where intraoperative contamination is often unavoidable. The presence of hematoma, serous fluid accumulation, and dead space in the surgical wound further predisposes patients to infection [4]. Various preventive measures, including preoperative antibiotic prophylaxis, strict aseptic surgical techniques, and postoperative wound management, have been employed to minimize SSI risk. However, additional strategies, such as the use of subcutaneous closed suction drains, have gained attention for their potential in reducing fluid accumulation, preventing bacterial proliferation, and promoting wound healing [5]. The effectiveness of subcutaneous closed suction drainage in reducing SSIs has been explored in various surgical specialties, with mixed findings. While some studies suggest a significant reduction in SSI rates, particularly in gastrointestinal and colorectal surgeries, others indicate no notable differences. Given the high burden of SSIs in emergency laparotomies and the limited data regarding the role of subcutaneous drains in this setting, further investigation is warranted [6].

This study aims to evaluate whether the placement of subcutaneous closed suction drains significantly reduces SSI incidence, minimizes bacterial colonization, and impacts postoperative recovery in emergency laparotomy patients. By generating evidence in this area, the findings could potentially guide clinical decision-making and improve surgical outcomes in high-risk patient populations.

2. REVIEW OF LITERATURE

Surgical Site Infections (SSIs) are one of the most prevalent healthcare-associated infections, leading to increased morbidity, prolonged hospital stays, and significant healthcare costs. Numerous studies have explored the etiology, risk factors, preventive measures, and management strategies for SSIs, with an emphasis on improving postoperative outcomes. This review of literature provides an overview of key concepts related to SSIs and the role of subcutaneous closed suction drains in reducing infection rates.

Surgical site infections are classified into superficial, deep, and organ-space infections, each varying in severity and management approach. The Centers for Disease Control and Prevention (CDC) defines SSIs based on their depth and timing, with infections occurring within 30 days of surgery or within one year if an implant is involved. Several patient-related and surgery-related factors contribute to SSI risk. Patient-related factors include age, immunosuppressive conditions, obesity, malnutrition, and diabetes mellitus, while surgery-related factors involve operative duration, wound classification, intraoperative contamination, and adherence to aseptic techniques.

The presence of hematomas, serous fluid, and dead space in a surgical wound creates an ideal environment for bacterial proliferation, increasing the risk of infection. Numerous studies emphasize the importance of proper wound management to minimize fluid accumulation and bacterial growth. Preventive measures such as preoperative skin antisepsis, prophylactic antibiotics, intraoperative sterile techniques, and postoperative wound care have been widely recommended to reduce the incidence of SSIs. Additionally, the use of subcutaneous drains has been explored as a potential strategy to facilitate wound healing by reducing fluid retention and eliminating infectious debris.

Subcutaneous closed suction drainage is a technique designed to remove accumulated fluid from the surgical wound, reducing the risk of bacterial colonization and preventing hematoma formation. Several studies have evaluated its effectiveness in different surgical settings. A meta-analysis by Ishinuki et al. in 2023 reviewed multiple clinical trials and reported a significant reduction in total SSIs among patients who received subcutaneous drains, particularly in gastrointestinal surgeries. Another study by Mahadik et al. in 2024 demonstrated that subcutaneous drainage lowered SSI rates and shortened hospital stays in patients undergoing emergency laparotomies. However, some studies have shown conflicting results, suggesting that the efficacy of subcutaneous drains may depend on patient characteristics, surgical technique, and postoperative care.

The role of subcutaneous drainage in emergency laparotomies remains an area of interest due to the substantial risk of intraoperative contamination and delayed wound healing in these cases. Research findings indicate that subcutaneous drains

may help reduce SSI rates, particularly in patients with high-risk factors such as obesity, diabetes, and prolonged operative time. However, variations in study design, sample size, and patient selection criteria contribute to discrepancies in reported outcomes. Further research is needed to establish standardized guidelines on the optimal use of subcutaneous drains in emergency surgical settings.

This study builds upon existing literature by evaluating the impact of subcutaneous closed suction drainage in emergency laparotomies, with a focus on infection rates, bacterial colonization, and postoperative recovery. By analyzing comparative outcomes between patients with and without subcutaneous drains, the study aims to provide evidence-based insights into their role in SSI prevention and overall surgical management.

3. METHODOLOGY

This study was designed as a prospective comparative study conducted in the Department of General Surgery at Vinayaka Mission's Kirupananda Variyar Medical College and Hospital, Salem. The primary objective was to assess whether the use of subcutaneous closed suction drains reduces the incidence of surgical site infections in emergency laparotomy patients.

The study included a total of 100 patients who underwent emergency exploratory laparotomies. Participants were randomly allocated into two groups: one group with subcutaneous closed suction drain placement before skin closure and the other without drain placement. Patients in the drain group were considered cases, while those without drains were designated as the control group. The drains were maintained for an average duration of 5.2 days, with a range of 3 to 12 days.

Inclusion criteria were patients aged 18 to 80 years undergoing emergency laparotomy. **Exclusion criteria** included patients below 18 or above 80 years, individuals with immunocompromised conditions such as HIV, chemotherapy, radiotherapy, diabetes, and those undergoing repeat laparotomy procedures.

Ethical approval was obtained from the Institutional Ethics Committee before initiating the study. Written informed consent was collected from all participants before data collection.

Demographic details, preoperative conditions, intraoperative findings, and postoperative outcomes, including SSI incidence, were recorded for each patient. Additional parameters assessed included total leukocyte count, intraoperative contamination, duration of hospital stay, and microbiological findings from pus culture and sensitivity.

The collected data were entered into Microsoft Excel and analyzed using SPSS software version 23. Descriptive statistics such as mean, standard deviation, and range were used for numerical variables, while categorical variables were represented in frequencies and percentages. Comparative analysis between the drain and non-drain groups was conducted using the chi-square test for categorical data and an independent t-test for continuous data. A p-value of less than 0.05 was considered statistically significant.

This methodology ensured a structured approach to assessing the effectiveness of subcutaneous closed suction drainage in preventing SSIs while maintaining ethical research standards and statistical rigor.

4. RESULTS

This study evaluated the impact of subcutaneous closed suction drains on surgical site infections (SSIs) in emergency laparotomy patients. A total of 100 participants were included, with 48 in the subcutaneous drain group and 52 in the non-drain group. The mean age was 43.7 years (± 17.09), with a male predominance (60%). The most common surgical indications were duodenal perforation (22%), intestinal obstruction (15%), and appendicular perforation (13%). The overall SSI incidence was 43%, with a significantly lower rate in the drain group (12.5%) compared to the non-drain group (71.15%). Bacterial growth was significantly lower in patients with subcutaneous drains, with 93.75% culture-negative cases compared to 26.92% in the non-drain group. Intraoperative contamination was also lower in the drain group (70.83% vs. 88.46%, $p = 0.028$). The mean postoperative hospital stay was comparable between both groups (11.85 vs. 11.46 days, $p = 0.746$).

Table 1: Age and Gender Distribution

A total of 100 participants were included in the study, with a **mean age of 43.7 years (± 17.09)**, ranging from 16 to 74 years.

Variable	Frequency	Percentage	Mean $\pm$ SD	Minimum	Maximum
Age (years)	-	-	43.7 $\pm$ 17.09	16	74
Male	60	60.0%	-	-	-
Female	40	40.0%	-	-	-
Total	100	100.0%	-	-	-

Table 2: Indications for Surgery

The most common indications for emergency laparotomy were **duodenal perforation (22%)**, **intestinal obstruction (15%)**, and **appendicular perforation (13%)**.

Diagnosis	Frequency	Percentage
Duodenal Perforation	22	22.0%
Intestinal Obstruction	15	15.0%
Appendicular Perforation	13	13.0%
Acute Intestinal Obstruction	10	10.0%
Obstructed Incisional Hernia	8	8.0%
Other Cases	32	32.0%
Total	100	100.0%

Table 3: Total Leukocyte Count

The mean **total leukocyte count** was **11,371.16 ($\pm 6,139.83$)**, ranging from **2,590** to **41,100**.

Variable	Mean $\pm$ SD	Range	Minimum	Maximum
Total Leukocyte Count	11,371.16 $\pm$ 6,139.83	38,510	2,590	41,100

Table 4: Incidence of Surgical Site Infection

The **incidence of SSI** was **significantly lower** in patients with subcutaneous drains (12.5%) compared to those without drains (71.15%) ($p < 0.001$).

Surgical Site Infection	Subcutaneous Drain (n=48)	No Drain (n=52)	Total (N=100)	p-value
Yes	6 (12.5%)	37 (71.15%)	43 (43.0%)	<0.001
No	42 (87.5%)	15 (28.84%)	57 (57.0%)	-

Table 5: Pus Culture and Sensitivity Findings

The **presence of bacterial growth** was **significantly lower** in patients with subcutaneous drains, with **93.75% culture-negative** cases compared to **26.92% in the non-drain group** ($p < 0.001$).

Bacterial Growth	Subcutaneous Drain (n=48)	No Drain (n=52)	p-value
No Growth	45 (93.75%)	14 (26.92%)	<0.001
Staphylococcus aureus	2 (4.16%)	18 (34.61%)	-
Escherichia coli	0 (0.00%)	11 (21.15%)	-
Klebsiella	1 (2.08%)	9 (17.3%)	-

Table 6: Intraoperative Contamination

Intraoperative contamination was **significantly lower in the subcutaneous drain group (70.83%) compared to the non-drain group (88.46%) (p = 0.028).**

Intraoperative Contamination	Subcutaneous Drain (n=48)	No Drain (n=52)	Total (N=100)	p-value
Yes	34 (70.83%)	46 (88.46%)	80 (80.0%)	0.028
No	14 (29.16%)	6 (11.53%)	20 (20.0%)	-

Table 7: Postoperative Hospital Stay

The **mean postoperative hospital stay was comparable between both groups (p = 0.746).**

Postoperative Stay (days)	Subcutaneous Drain (n=48)	No Drain (n=52)	p-value
Mean ± SD	11.85 ± 6.47	11.46 ± 5.61	0.746

Table 8: Age Distribution with Subcutaneous Drain

There was no significant difference in age distribution between the groups (p = 0.433).

Subcutaneous Drain	N	Mean Age ± SD	Mean Difference	p-value
Yes	48	45.10 ± 16.1	2.7	0.433
No	52	42.40 ± 18.02	-	-

Table 9: Type of Anesthesia with Subcutaneous Drain

The distribution of anesthesia type was comparable between groups (p > 0.05).

Anesthesia	Subcutaneous Drain (n=48)	No Drain (n=52)	Total (N=100)	p-value
General	36 (75.0%)	35 (67.3%)	71 (71.0%)	0.114
General + Epidural	10 (20.83%)	16 (30.76%)	26 (26.0%)	-
Spinal	2 (4.16%)	0 (0%)	2 (2.0%)	-
Spinal + Epidural	0 (0%)	1 (1.92%)	1 (1.0%)	-

Table 10: Duration of Subcutaneous Drain

The **mean duration of subcutaneous drain placement was 7.15 days (±2.55), ranging from 3 to 12 days.**

Duration of Subcutaneous Drain (days)	Mean ± SD	Minimum	Maximum
Subcutaneous Drain	7.15 ± 2.55	3	12

5. DISCUSSION

This study aimed to evaluate the effectiveness of subcutaneous closed suction drains in reducing surgical site infections (SSIs) in patients undergoing emergency laparotomy. The findings demonstrated a significant reduction in SSI incidence among patients who received a subcutaneous drain compared to those without a drain. This section discusses the study's key findings, compares them with existing literature, and highlights the implications for surgical practice.

Incidence of Surgical Site Infection: A primary finding of this study was that 12.5% of patients with subcutaneous drains

developed SSIs, whereas the infection rate was significantly higher at 71.15% in the non-drain group ($p < 0.001$). This result is consistent with previous studies that have reported lower SSI rates in patients with subcutaneous drainage [7].

- Mahadik et al. (2024) found that SSI incidence was significantly lower in patients with drains (24%) compared to those without (56%) [8].
- Naik, Arya, and Ashok (2021) similarly reported that patients with subcutaneous drains had an SSI rate of 24%, compared to 46% in those without drains [9].
- Watanabe et al. (2017) reported a 4.5% SSI rate in patients with drains compared to 12.8% in the control group, demonstrating the preventive effect of subcutaneous suction drainage [10].

The results suggest that subcutaneous closed suction drainage is an effective measure for reducing SSIs in emergency laparotomy patients. The mechanism behind this reduction is likely due to the drain's ability to eliminate accumulated serous fluid and blood, which could otherwise serve as a medium for bacterial proliferation.

Microbiological Analysis of Pus Culture

The microbiological analysis in this study revealed that patients with subcutaneous drains had significantly lower bacterial growth in their pus culture samples compared to those without drains.

- 93.75% of patients with subcutaneous drains had no bacterial growth, compared to only 26.92% in the non-drain group ($p < 0.001$).
- Staphylococcus aureus was the most frequently isolated pathogen in the non-drain group (34.61%), followed by Escherichia coli (21.1%) and Klebsiella (17.3%).
- In contrast, the presence of these bacteria was significantly lower in the drain group, with only 4.16% for Staphylococcus aureus, 0% for Escherichia coli, and 2.08% for Klebsiella.

These findings align with previous research, where Escherichia coli and Staphylococcus aureus were the predominant organisms associated with SSIs. The significant reduction in bacterial colonization in the drain group reinforces the role of subcutaneous drainage in preventing wound infections by removing bacterial contaminants and reducing dead space, which are essential for microbial growth.

Intraoperative Contamination and Postoperative Outcomes: This study found a significant association between intraoperative contamination and the use of subcutaneous drains.

- 70.83% of patients with subcutaneous drains had intraoperative contamination, compared to 88.46% in the non-drain group ($p = 0.028$).

The lower intraoperative contamination rate in the drain group suggests that subcutaneous drainage may contribute to better wound healing by reducing the bacterial burden at the surgical site. This is particularly important in emergency laparotomy cases, where intraoperative contamination is often unavoidable due to bowel perforations or peritoneal sepsis.

Postoperative Hospital Stay

Interestingly, there was no significant difference in postoperative hospital stay between the drain and non-drain groups.

- The mean hospital stay in the drain group was 11.85 ± 6.47 days, compared to 11.46 ± 5.61 days in the non-drain group ($p = 0.746$).

Previous studies have reported variable effects of subcutaneous drains on hospital stay:

- Mahadik et al. (2024) found that patients with SSIs had a longer hospital stay (15.85 days) compared to those without infections (7.43 days), suggesting that reducing SSIs indirectly shortens hospitalization [8].
- Harish, Kazi, and Sharma (2021) reported that patients with subcutaneous drains had shorter hospital stays compared to those without [11].
- Pang et al. (2021) found no significant difference in hospital stay among patients undergoing colorectal surgeries with or without subcutaneous drains [12].

The findings of the present study indicate that although subcutaneous drains effectively reduce SSIs, they do not necessarily reduce hospital stay, which may depend on other factors such as surgical complexity, patient comorbidities, and postoperative recovery rates.

Comparison with Previous Studies

The results of this study strongly support the use of subcutaneous closed suction drainage in emergency laparotomies. A comparison with major studies on the topic further confirms these findings:

Study	SSI Rate (Drain Group)	SSI Rate (Non-Drain Group)	Key Findings
Current Study (2024)	12.5%	71.15%	Significant reduction in SSIs with subcutaneous drains.
Mahadik et al. (2024)	24%	56%	Lower SSI and shorter hospital stay with drains [8].
Naik et al. (2021)	24%	46%	Drains reduced SSI incidence [9].
Watanabe et al. (2017)	4.5%	12.8%	Significant reduction in incisional infections [10].
Fujii et al. (2011)	14.3%	38.6%	Drains were particularly effective in obese patients [13].

This comparison highlights the convincing evidence supporting the role of subcutaneous drainage in reducing SSIs, particularly in high-risk surgical cases such as emergency laparotomies.

Clinical Implications

The findings of this study have important clinical implications:

1. Routine Use in High-Risk Surgeries – Given the substantial reduction in SSIs, subcutaneous closed suction drainage should be considered as a routine preventive measure in emergency laparotomies, particularly in patients with a substantial risk of infection (e.g., bowel perforations, peritonitis, immunocompromised patients) [14].
2. Microbiological Monitoring – Since bacterial growth was significantly lower in the drain group, routine pus culture and sensitivity testing may be beneficial for identifying potential infections early [15].
3. Standardized Drainage Protocols – Future research should focus on establishing standardized guidelines regarding optimal drain placement, duration, and removal protocols to maximize benefits while minimizing complications [16].

Strengths and Limitations of the Study

This study provides valuable evidence on the effectiveness of subcutaneous closed suction drains in emergency laparotomies. However, certain limitations should be acknowledged:

- Single-center study – The findings are specific to one institution and may not be generalizable to all settings.
- Diverse surgical indications – The study included multiple types of emergency laparotomies, which may introduce variability in outcomes.
- Limited assessment of drain-related complications – While this study focused on SSIs, further research is needed to evaluate potential drain-related complications such as seroma formation, pain, and delayed healing.

Future multi-center randomized controlled trials are recommended to validate these findings and establish comprehensive guidelines for subcutaneous drainage in emergency surgical cases.

This study demonstrated that subcutaneous closed suction drains significantly reduce SSIs in emergency laparotomy patients without prolonging hospital stays. The microbiological findings further support the effectiveness of drainage in minimizing bacterial colonization. Given the high burden of SSIs in emergency surgeries, implementing subcutaneous drainage as a standard preventive measure could significantly improve surgical outcomes.

6. CONCLUSION

This study demonstrated that the use of subcutaneous closed suction drains in emergency laparotomy patients significantly reduces the incidence of surgical site infections while maintaining a comparable postoperative hospital stay. Patients in the drain group had a markedly lower SSI rate (12.5%) compared to those without drains (71.15%, $p < 0.001$), with a significant reduction in bacterial colonization as evidenced by 93.75% culture-negative cases in the drain group versus 26.92% in the non-drain group. Additionally, intraoperative contamination rates were lower in patients with subcutaneous drains (70.83% vs. 88.46%, $p = 0.028$), reinforcing their protective effect against infection. Despite the reduction in SSIs, the mean postoperative hospital stay was similar between the groups, indicating that the use of subcutaneous drains does not prolong recovery. These findings support the routine implementation of subcutaneous closed suction drains in emergency laparotomies, particularly in high-risk patients, to minimize postoperative infections and improve surgical outcomes. Future research should focus on optimizing drainage protocols, assessing long-term patient recovery, and conducting multicenter trials to further validate the benefits of subcutaneous drainage in emergency surgical settings.

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