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Original Research Article

A prospective case-control study on the efficacy of subcutaneous suction drainage in reducing surgical site infections following laparotomy

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ABSTRACT

Background: Surgical site infections (SSIs) are one of the major postoperative complications and their management still remains to be a gruelling task. The worldwide incidence of SSI ranges between 0.5 and 15%, but in India it shows a significant increase of about 23 to 38%. The placement of suction drains in surgical wounds has proved to be quite promising especially in emergency laparotomies. The objective of this study was to compare the incidence of SSIs in abdominal surgical wounds with subcutaneous suction drains versus those where drains were not used.
Methods: This is a case-control study of 60 patients undergoing midline exploratory laparotomy surgeries admitted in the gastrosurgery and general surgery department of Hitech Medical college and Hospital, Bhubaneswar. Among them, closed subcutaneous drain was placed before the skin closure for every alternate patient and for the others no subcutaneous drain was placed. The patients for whom subcutaneous drain were placed were considered as cases while the other group of patients were considered as control group.
Results: The patients in the case group had lower incidence of SSI compared to the control group. When compared between the emergency and elective cases, the emergency cases showed higher propensity for SSI.
Conclusions: Subcutaneous suction drains have proved to be safe and effective in preventing SSIs in abdominal surgeries, especially in emergency and colorectal surgeries.

Keywords: Surgical site infection, Subcutaneous suction drain, Comorbidity, Elective surgery, Emergency surgery

INTRODUCTION

Surgical site infections (SSIs) remain one of the most prevalent and serious complications in postoperative care, significantly contributing to patient morbidity, prolonged hospital stays, and increased healthcare costs. SSIs are defined as infections occurring at or near the surgical incision site within 30 days of the procedure or within 90 days; if infection involves deeper tissues.[1]

The incidence of SSIs varies globally between 0.5% and 15%, with reports from India indicating a significantly higher prevalence ranging from 23% to 38%, highlighting a substantial burden in low- and middle-income settings.[2]

Several factors contribute to the pathogenesis of SSIs, e. g: Microbial virulence and the inoculum size at the surgical site. The presence of dead space, hematomas, or devitalized tissue, which serve as niduses for infection.

Inadequate surgical technique, especially when foreign materials such as drains or sutures are left *in situ*.

Patient-specific risk factors such as high body mass index (BMI), history of alcoholism, diabetes mellitus, chronic cardiac conditions, and immunosuppressive states significantly elevate the risk.[3]

The type and urgency of the surgical procedure play a vital role in development of SSIs. Patients undergoing emergency surgeries i.e. emergency laparotomy, are at a heightened risk compared to those undergoing elective, clean procedures due to factors like presence of

contaminated wounds and polymicrobial exposure, which can result in systemic dissemination of infection.[4]

Clinical manifestations of SSIs include localized signs such as erythema, warmth, pain, induration, and purulent discharge. Systemic features such as fever and malaise may also be present. In severe cases, SSIs can progress to wound dehiscence or even sepsis if not promptly and adequately managed.

The placement of subcutaneous drains, especially in emergency laparotomies, has shown promise in reducing SSI incidence. These drains facilitate the evacuation of collected fluid and prevent accumulation of blood or exudate, thereby eliminating dead space and reducing bacterial colonization.[5] Their use is particularly beneficial in contaminated or dirty wounds.

Aims and objectives

Aim and objectives were to evaluate the efficacy of subcutaneous suction drainage in minimizing the incidence of SSIs and to compare the incidence of SSIs between elective and emergency exploratory laparotomy procedures.

METHODS

A prospective, randomized case-control study was conducted on 60 patients undergoing midline exploratory laparotomy in the department of general surgery and gastrosurgery of Hi-Tech Medical College and Hospital, Bhubaneswar, between January 2024 and June 2024. All participants underwent clinical evaluation and relevant investigations after obtaining the informed written consent.

Intervention group (cases)

The 30 patients received a closed subcutaneous suction drain placed prior to skin closure.

Control group

The thirty patients did not receive the subcutaneous drainage.

The subcutaneous drains were inserted along the entire subcutaneous layer, with exit sites separate from the primary incision and were retained for a duration of 7-15 days.

Study design

It was a prospective case-control study with simple randomization.

Cases included patients who received subcutaneous suction drains and controls included patients without subcutaneous drains.

Inclusion criteria

Patients with aged >18 years and patients undergoing elective or emergency midline laparotomy were included in the study.

Exclusion criteria

Patients with aged <18 years or >80 years, patients with immunocompromised status (e.g., HIV, undergoing radiotherapy/chemotherapy) and patients undergoing re-do laparotomy procedures were excluded from the study.

Surgical technique summary

Skin incision was performed using a scalpel, followed by dissection of subcutaneous fat with electrocautery.

Fascia/muscle closure

Continuous suture with loop prolene.

Skin closure

2-0 Ethilon interrupted sutures. o Procedural variation between study groups except for placement of the suction drain in the intervention group.

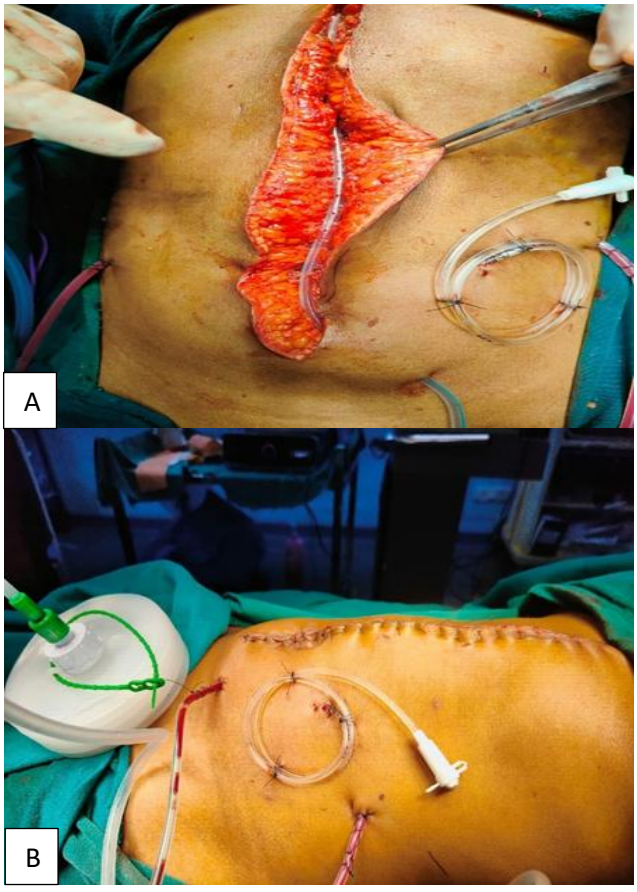

Figure 1 (A and B): Wound closure with subcutaneous suction drain.

Criteria for diagnosing SSIs

Purulent drainage from the superficial incision, with or without laboratory confirmation. Microbial isolation from fluid/tissue obtained aseptically from the superficial incision. Presence of clinical signs of infection: localized pain or tenderness, swelling, redness, or heat at the superficial incision site.

Incisions deliberately reopened by the surgeon due to suspected infection (unless culture-negative). Clinical diagnosis of superficial SSI by the infection control team or operating surgeon.

Statistical analysis

The data was entered into Microsoft excel worksheet and analysed using statistical package for social sciences (SPSS) version 25.0. Normality of data was assessed using Shapiro-Wilk's test and appropriate analytical statistics were employed.

Mean and standard deviations were computed for parametric variables. Frequency and proportion were computed for categorical variables. Independent t test was used to compare Continuous variables whereas Chi-square statistics was assessed for categorical variables. A $p<0.05$ was considered significant for all statistical inferences.

RESULTS

The mean age of participants in the case group was 49.17±14.67 years, while that of the control group was 48.73±15.53 years.

On comparison with independent t-test, there was no significant difference in mean age ($p=0.9$) between cases and controls.

Statistical analysis demonstrated no significant difference in the mean age distribution between the two groups, indicating demographic comparability in terms of age.

In the case group, a total of 6 patients were diagnosed with diabetes mellitus,5 patients presented with obesity, and 6 patients exhibited co-occurrence of both diabetes mellitus and obesity.

In the control group, 10 individuals were identified as having diabetes mellitus, 5 were obese and 2 individuals demonstrated both diabetes and obesity concurrently.

Statistical analysis revealed no significant difference in the distribution of comorbidities (diabetes and obesity) between the case and control groups.

In the case group, 19 patients underwent elective surgical procedures, whereas 11 patients required emergency surgical intervention.

In contrast, within the control group,21 patients received elective surgery, and 9 patients were subjected to emergency surgery.

There was no statistically significant difference in the distribution of surgical intervention types (elective vs. emergency) between the case and control groups.

The association between the type of surgical procedure and the incidence of SSIs was analyzed. Among patients who underwent elective surgeries, 14 out of 40 individuals (35%) developed SSIs, while the remaining 26 patients did not exhibit any postoperative infection.

In contrast, among the 20 patients who underwent emergency surgical interventions, 11 patients (55%) developed SSIs, whereas 9 patients remained free of infection.

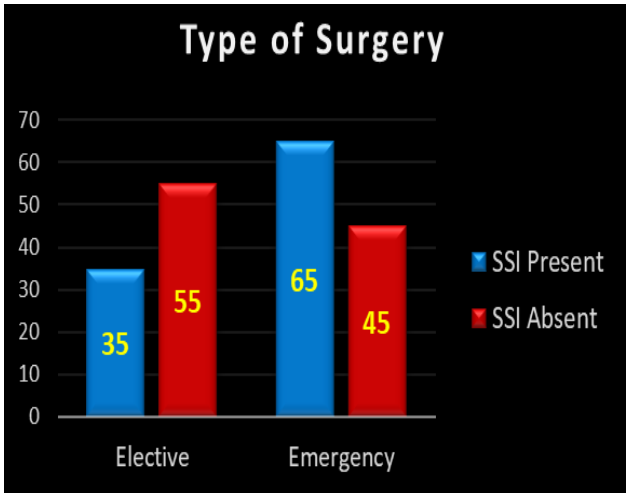

Figure 2: Types of surgery.

These findings indicate a statistically significant difference in SSI incidence based on the type of surgery. Emergency surgeries demonstrated a higher infection rate compared to elective procedures. This elevated risk may be attributed to the increased number of contaminated cases such as gastrointestinal perforations and blunt abdominal trauma, which are more common in emergency settings. In comparison, elective surgeries predominantly involved clean cases, thereby reducing the risk of infection.

In the case group, 6 patients (20%) developed SSIs, while the remaining 24 patients (80%) showed no signs of infection. Conversely, in the control group, 19 patients (63.3%) developed SSIs, whereas only 11 patients (36.7%) remained infection-free.

There was a significant association ($p<0.001$) between SSI and presence of drain.

A statistically significant difference was observed in the distribution of SSIs between the two groups. Notably, the control group exhibited a significantly higher incidence of

SSIs compared to the case group. This reduction in infection rate within the cases may be attributed to the use of a subcutaneous closed suction drain.

The mean duration of hospitalization in the case group was 7.97±2.58 days, whereas in the control group it was 10.53±2.88 days.

Table 1: Comparison of age groups between cases and controls.

Age group (in years)	Case	Control
<30	4	3
31-40	6	5
41-50	6	6
51-60	4	7
>60	10	9

Table 2: Comparison of age groups between cases and controls.

Groups	Mean age (in years)	Standard deviation	Mean difference	T	P value	95% CI
Cases	49.17	14.67	0.43	0.11	0.9	-7.43 to 8.29
Controls	48.73	15.53				

Table 3: Comparison of distribution of comorbidities among cases and controls.

Comorbidity	Cases, N (%)	Controls, N (%)	Chi-square	P value
Obesity	5 (16.7)	5 (16.7)	3.01	0.39
T2 DM	6 (20)	10 (33.3)		
Obesity and T2 DM	6 (20)	2 (6.7)		
None	13 (43.3)	13 (43.3)		

Table 4: Distribution of type of surgery among cases and controls.

Surgery	Cases, N (%)	Controls, N (%)	Chi-square	P value
Elective	19 (63.3)	21 (70)	0.3	0.58
Emergency	11 (36.7)	9 (30)		

Table 5: Incidence of SSI based on type of surgery.

Type of surgery	Elective, N (%)	Emergency, N (%)	Chi-square	P value
SSI present	14 (35)	11 (55)	2.19	0.14

Table 6: Incidence of SSI between cases and controls.

SSI	Cases, N (%)	Controls, N (%)	Chi-square	P value
Yes	6 (20)	19 (63.3)	11.58	<0.001
No	24 (80)	11 (36.7)		

Table 7: Comparison of hospital stay between cases and controls.

Hospital stay	Mean	Standard deviation	Mean difference	T	P value	95% CI
Cases	7.97	2.58	-2.56	-3.62	0.001	-3.98 to -1.25
Controls	10.53	2.88				

On comparison with independent t-test, there was a significant difference in mean hospital stay (p=0.001) between cases and controls. The mean hospital stay was lesser in patients with subcutaneous drain.

This observation suggests that, on average, patients in the control group required approximately 11 days of inpatient care, indicating a prolonged hospital stay in comparison to the case group. Patients in the control group, had longer hospital stays compared to those in case group. Increased duration of stay in control group is likely attributable to the higher incidence of SSIs. Therefore, the presence of SSI associated with increased postoperative morbidity, which directly contributed to an extended length of stay.

DISCUSSION

The above study compared two patient groups with respect to comorbidities, surgical variables, SSI incidence, and hospital stay duration. There was no significant difference in the distribution of diabetes and obesity or the type of surgery (elective vs. emergency) between the case and control groups. However, emergency surgeries were associated with a significantly higher rate of SSIs than elective procedures. The case group, in which subcutaneous closed suction drains were used, demonstrated a significantly lower SSI incidence (20%) compared to the control group (63.3%). Additionally, the mean hospital stay was significantly shorter in the case group (8.84±2.85 days) than in the control group (11.2±4.85 days), indicating reduced postoperative morbidity associated with the use of drainage.

SSIs represent a significant postoperative complication, particularly following gastrointestinal, colorectal, hepatobiliary procedures and emergency laparotomies, contributing to increased morbidity, prolonged hospitalization, and elevated healthcare costs.[6] Numerous risk factors are implicated in SSI pathogenesis, including smoking, elevated BMI, subcutaneous fat thickness, poor glycemic control, nutritional status, ASA class, and operative time. Obesity has been shown to elevate wound complication rates from 7% to 23%.[7,8]

Subcutaneous drains have been explored as an intervention to mitigate SSI risk by evacuating serous fluid, hematomas, and minimizing dead space, thereby reducing bacterial colonization.[9] Although prophylactic subcutaneous drainage has gained acceptance in surgical practice, its efficacy remains controversial. Studies report that SSI incidence is exacerbated by factors such as fluid accumulation and increased bacterial load. The presence of a subcutaneous drain may reduce these risks; however, the timing of drain removal is critical. Premature or delayed removal may either fail to prevent infections or elevate the risk due to prolonged foreign body presence.[10] Recent clinical investigations demonstrate a lower incidence of SSI in patients receiving subcutaneous closed suction drains postoperatively.

Comparable findings have been reported by Wani et al demonstrating that 12% of cases and 45.3% of those in the control group exhibited wound dehiscence, with statistical significance ($p<0.001$).[11] Khan et al further substantiated these outcomes, indicating that 14% of patients with postoperative drain placement and 42% of those without drains developed wound dehiscence, again with statistically significant results ($p= 0.002$).[12] Conversely, a study conducted by Alsafrani et al presented contradictory evidence, challenging the aforementioned observations.[13]

Nonetheless, this study has several methodological limitations. Chief among them is the limited sample size, which restricts the external validity and generalizability of the findings. Additionally, the investigation was confined to a single-centre setting, further constraining its applicability. Moreover, numerous established risk factors for SSI were not accounted for in this analysis, potentially impacting the comprehensiveness of results. Some factors have not been included in analysis, such as preoperative conditions, the length of surgery, the surgical technique, the surgeon's experience, the material of the drain and the timing of drain removal. Several specific clinical outcomes, such as pain control, cosmetic evaluations, medical cost and quality of life of patients to be clarified in future studies to enhance postoperative outcomes.

CONCLUSION

The results from the present study shows that subcutaneous suction drainage effectively reduces SSI incidence and shortens hospital stay, particularly in contaminated or emergency surgical settings. However larger group studies are required for better results.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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