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Efficacy Of Subcutaneous Suction Drain In Reducing Postoperative Surgical Site Infection In Laparotomy Cases

Dr Abhishek Mahadik[1], *Dr Abhijit Budhkar[2], Dr Shshank Jain [2], Dr Aniket Patil [3], Dr Nikhil Beldar[4]
[1,2]Astt Prof Surgery, [3]SR General Surgery, [4]Resident General Surgery,
D Y Patil Hospital Navi Mumbai, Mumbai, INDIA

***Corresponding Author:**
Dr. Abhijit Budhkar
Astt Prof Surgery, D Y Patil Hospital Navi Mumbai, Mumbai, INDIA

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Abstract

Background

Surgical site infections (SSIs) post invasive surgical procedure continues to be serious morbidity for individuals. In surgical incision wounds, hematoma, serous fluid, and dead space increase the risk of infection because they provide surface for microbial growth. There were several ways proposed to lower these hazards. We attempted to determine the prevalence of SSI following the insertion of a closed suction drain after surgery, evaluate the effectiveness of subcutaneous wound drainage in lowering SSIs, assess the incidence of SSI following both emergency and elective exploratory laparotomies &determine most common pathogen causing SSIs

Material And Method

In Tertiary Care Hospital-Based Prospective case–control study with simple randomization of 50 patients after receiving informed written consent undergoing midline exploratory laparotomy surgeries (elective and emergency) over 9 months in surgical department, a closed subcutaneous suction drain was inserted before the skin was closed in 25 of these patients at random, whereas remaining 25 patients subcutaneous suction drain not kept. Subjects with subcutaneous drain implanted were treated as cases, whereas other group was considered control.

Result

In significant number of patients, subcutaneous suction drains shown to lower SSI. The incidence of SSI was higher among comorbid patients and emergency cases. E. coli was the isolate with the highest frequency. Additionally, patients with SSI had higher average hospital stay.

Conclusion

Patients with SSI have increased morbidity and patients who have major procedures are more likely to experience SSI afterward. A subcutaneous closed suction drain's existence contributes to SSI reduction.

Keywords: drains, laparotomy, surgery, microbial growth, surgical site infections

Introduction

Wound healing and its complications continue to be the main concern in postoperative patients since they tend to raise morbidity levels. The cornerstone of surgical practice is wound management, and treating infections associated with open wounds is still debatable. [1 2]

Surgical site infections are one such serious postoperative consequence (SSIs). SSIs are infections wherein the microorganisms infiltrate the tissues within 30 days after the surgery for the superficial layers, and within 30 or 90 days for the deep layers.

SSIs are further divided into two types: incisional and organ/space. While incisional SSIs are restricted to surgical sites, they can be subcategorized into superficial and deep SSIs.

1. The superficial SSIs affect the skin and superficial fascia;
2. The deep SSIs involve the infection of the fascial and muscular layers.
3. Organ/space SSIs infect any tissue below the fascial layer which is involved in the surgical procedure within 30 or 90 days after the surgery.

The incidence of SSI varies between 0.5 and 15% globally, however, it has significantly increased by 23 to 38% in India.

The likelihood of developing SSI after surgery relies on the virulence of the bacteria and quantity of their inoculum.

Increased dead space, hematoma, or devitalized tissue—all results of subpar surgical techniques—increase the risk of infection. It also applies to any other foreign object, such as stitches or drains. The development of SSI has also been linked to patients with high BMI, documented histories of alcoholism, chronic cardiac disease, and diabetes.

This is mostly because they result in a generalized decline in immune activity, which delays wound healing. The kind of injury and procedure also matters; SSI is more likely to occur after an emergency operation on a contaminated wound (such as an emergency abdominal laparotomy) than it is after an elective procedure on a clean lesion. This is a result of germs that may have infiltrated the bloodstream through contaminated wounds and caused SSI.

There have been several suggested strategies to reduce surgical site infection. Many of them, such as limiting shaving, hand washing, and preoperative antibiotics, have been employed by surgeons on regular basis and well-acknowledged.

It is believed that gut microbes can grow more easily in presence of fluids and necrotic tissue in subcutaneous layer, leading to surgical site infections. [3 4] The incisional SSIs are therefore thought to be efficiently controlled by removing contaminated subcutaneous fluids and necrotic tissue. [5] Theoretically, incisional SSIs can be decreased by inserting subcutaneous suction drainage tube to remove contaminated subcutaneous fluids and necrotic tissue from the subcutaneous layer in early postoperative stage before they develop infections. Subcutaneous suction drainage tubes to prevent surgical site incisions were subject of numerous RCTs. However, some RCTs had favourable outcomes, while others had unfavourable outcomes [6–7].

The use of subcutaneous drain in surgical wounds following procedure, particularly in emergency laparotomies, has, however, appeared to be extremely advantageous. The idea behind it is to eliminate any accumulated fluid or debris and close any dead spaces in subcutaneous plane, which will lessen the risk of infection and wound problems.

Aims And Objectives

1. To evaluate the effectiveness of subcutaneous wound drainage in lowering SSIs.
2. To assess the incidence of SSI following both emergency and elective exploratory laparotomies.
3. To determine which organism causes the majority of SSIs
4. To assess the role of predictive factors in wound infection like diabetes, low Hb, and low albumin

Material And Methods

1. This is a Tertiary Care Hospital-Based Prospective case–control study with simple randomization. of 50 patients undergoing midline exploratory laparotomy surgeries admitted between 1 JANUARY TO 30 SEPTEMBER in the surgical department of DR.D.Y.PATIL MEDICAL SCHOOL.
2. All admitted patients underwent clinical examination with relevant investigations after obtaining informed written consent.
3. Among these, 25 patients were randomly selected and a closed subcutaneous suction drain was placed before skin closure, while other 25 patients subcutaneous drain was not placed.
4. The patients with subcutaneous drain were considered as cases while the other group was regarded as control group.

5. Patients are divided according to wound class clean-contaminated, contaminated, and dirty.
6. Drains were kept in-situ for a duration of 5 to 15 days (average of 5.2 days).
7. Drains removed when output was < 5 mL. The sutures were cut and taken out either before or sometimes after discharge of patient at least after 8 days depending upon the wound site condition.
8. The patient was followed up in hospital outpatient department for up to 30 days postoperatively.
9. SSI cases were diagnosed within 30 postoperative days by ICT according to centers for disease control and prevention (CDC) criteria:
    - Purulent drainage with or without laboratory confirmation from superficial incision
    - Organisms isolated from an aseptically obtained culture of fluid or tissue from superficial incision
    - At least one of the following signs or symptoms of infection: Pain or tenderness, localized swelling, redness, or heat, and superficial incision was deliberately opened by surgeon unless incision was culture-negative
    - Diagnosis of s-SSI by the surgeon or ICT

Inclusion Criteria

1. Age more than 18 yrs
2. Patients undergoing elective and emergency laparotomy surgeries
3. their subcutaneous fat thickness was more than 2.5 cm

Exclusion Criteria

1. Patients below 18 years
2. Patients above 80 years
3. Patients with immunocompromised status like HIV, radiotherapy, chemotherapy
4. Re-done laparotomy surgeries

Procedure:

1. According to The CDC criteria, patients have been advised to bath or shower with an antiseptic agent the night before surgery.
2. Shaving was performed as close to the time of surgery in order to reduce risk of microbial growth in breaks in the skin.
3. Just as with surgical scrub, the ideal duration of skin prep has not been established. However, the skin prep lasts a minimum of five minutes with 7.5% povidone-iodine, diluted spirit, povidone-iodine 10%
4. Once the sterile gloves have been put on, skin preparation is started at the location of intended incision and moved outward in an ever-widening circular motion. The sponge has been discarded after the limits or periphery of skin preparation have been reached. We followed most crucial rule of skin preparation is that always work from the clean to the unclean area.
5. Scalpel blade no.23 used for surgical incision; electrocautery used to separate subcutaneous fat. The skin was closed with 2-0 ETHILON, and the fascia/muscle layer was closed with continuous loop ETHILON. The only variation between the latter and the earlier period's surgical techniques was the insertion of a suction drain down the whole length of the subcutaneous tissue. It was separated from incisions where the drain exited.
6. The quantity and kind of effluent fluid that was routinely retrieved following emptying of negative suction container, as well as state of the wound, were taken into consideration when determining appropriate time to remove SCSD catheter.
7. Intra-operative measures to avoid surgical site infection:
    - All operative procedures were consistently performed by consultant surgeons. A standardized protocol to reduce rates of surgical site infection was applied in all patients.

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- All patients received prophylactic antibiotic [Third generation cephalosporin] treatment during induction of anesthesia and another dose if surgery continued for more than 3 hours. Peritoneal irrigation/lavage was carried out using at least 5 litres warm saline followed by appropriate placement of intra-abdominal drains. Details about the surgery/operation were noted
- Operative wounds were classified according to the definition being given by the American College of Surgeons as:
    1. Clean
    2. Clean contaminated
    3. Contaminated
    4. Dirty

8. The first dressing was changed after 48 hours and incision site was closely monitored for pain, tenderness, induration, redness, discharge, swelling, increased local warmth, and suture with tension.
9. Discharge was collected and sent for culture and sensitivity.
10. Criteria of wound infection:
    a. Wound infection is described as:
        - Incisional—When it is located above the fascial layer
        - Deep—When it is located below the fascial layer.
    b. Types of discharges through the wound are:
        - Serous
        - Seropurulent
        - Purulent
        - Feculent.
11. For all 50 patients, the dressing was done by the same person by taking all aseptic precautions. Drain were emptied & measured on a 24 hr basis.

Discussion

In this study, we addressed the influence of SCSD during closure of midline laparotomy in setting of elective and emergency abdominal surgery. This approach correlated with significant reduction of SSI, wound dehiscence, laparotomies and increased rates of successful conservative management for intraperitoneal infection. Subsequently, rates of incisional hernia also significantly decreased.

One of the main reasons for morbidity in emergency laparotomies is SSI. The incidence, prevention, and treatment of SSIs have all been extensively studied. Because of organisms that live in the intestines, colorectal procedures have been demonstrated to have a significant incidence of surgical site infections (SSI). [8 9] In an effort to identify the risk factors producing SSI, "Cruse and Foord" demonstrated that the mean rate of infection was 4.8% in various surgical disciplines, with increased infections in the elderly, long hospital stays, and procedures. [9] Our findings were different from theirs in that their research indicated that the rate of infection also rose as a result of use of drains.

A subcutaneous drain might reduce number of bacteria around wound and remove residual effusion and blood from wound that could serve as a medium for bacterial growth. Many studies from India at different places have shown the SSI rate to vary from 6.09% to 38.7% [10,11,12]

In our research, we found that SSI rates came up to 24% in patients with a subcutaneous drain and 56% in those without a drain. Also, in our study, The mean age in the No-Drain group was 46.48 ± 19.04 years, and in the Drain group was 46.40 ± 12.93 years. There was no significant difference in mean age comparison between the two groups.

The incidence of SSI in our study was 40%. The infection rate in Indian hospitals is found to be higher than that in other countries; for instance, in the USA, it is 2.8% and it is 2-5% in European Countries. [10] In a study by Satyanarayan et al,[13] the infection rate was more with emergency surgery (25.2%) when compared to elective surgery (7.6%). In our study also, the infection rate was more with emergency

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surgery (26%) when compared to elective surgery (14%) The high rates of infection in emergency surgeries can be attributed to inadequate pre-operative preparation, the underlying conditions which predisposed to the emergency surgery and the more frequency of contaminated or dirty wounds in emergency surgeries.[10]However, hypertensive and diabetic patients did not seem to have been significant factors in the development of SSI. Previous studies have also revealed that SSI development leads to longer hospital stays. In the present study, we found out that this was true. There was no significant association between comorbidities and the groups (P=0.105), which shows that the groups are independent of comorbidities. There was no statistically significant association between surgical site infection and comorbidities (P=0.821), which shows that surgical site infection is not dependent on the comorbidities in the No-Drain group. But we also found that Surgical site infection was more prevalent in patients with comorbidities in Drain group patients. The mean output of drain in patients with comorbidity was 89.09 ± 14.46 ml and in patients without comorbidities was 69.29 ± 15.42 ml. The mean output of drain was significantly higher in patients with comorbidities in comparison to the patients without comorbidities (P=0.003). The patients who developed SSI had a mean stay of 15.85 ± 2.87 days and the patients who did not develop surgical site infection had a mean duration of 7.43 ± 1.28 days. This is mainly due to the fact that SSI management involves close monitoring, repeated dressings, and antibiotic treatment.

According to "Suragul" and his associates, 48% of the cultures tested positive for polymicrobial causes of SSI. The most frequent pathogens in abdominal surgery are Enterococcus, E. coli, and Klebsiella pneumonia, which are common occupants of the intestines. Our research has indicated that E. coli was the most frequent bacterium isolated in the study, followed by Klebsiella pneumonia.

Numerous studies have identified a number of separate risk factors that are connected to the occurrence of incisional SSIs following colorectal surgery. These risk variables include diabetes mellitus [17], preoperative anemia (19), hypoalbuminemia (18), classification of the wounds (20), the thickness of the subcutaneous fat (22), and others. We selected these patients to participate in our study in order to increase the contrast of incisional SSIs rates in the two groups. These patients had diabetic mellitus, hypoalbuminemia (ALB 30 g/L), anaemia (Hb 10 g/L). In our study, The prevalence of SSI was higher in patients with a duration of surgery >=5 hours. The prevalence of SSI was higher in patients with albumin levels <=3. The prevalence of SSI was higher in patients with hemoglobin levels <10 gm%. The drainage tube is not suitable for thin patients. Therefore we chose the patients with a thickness of subcutaneous fat greater than 2.5 cm

After dissection and suture (particularly when using an electric knife), subcutaneous fat is easily necrosed and liquefied (23), and numerous studies have demonstrated that obesity increases the risk of post-operative infection (24). It is believed that gut microbes will proliferate more readily in the presence of fluids and necrotic tissue in the subcutaneous layer, leading to a rise in SSI. The gut microbes from the colorectal tract are easily multiplied in this environment, particularly in individuals with inadequate immunity (25). According to several research, incisional infection following colorectal surgery became apparent three to five days after the procedure (26). As a result, the initial phase following surgery is crucial for SSIs. During this time, prevention is essential. If the fluids and necrotic tissue that would encourage the growth of microorganisms early after surgery can be eliminated successfully, it is thought that wound infection would be decreased. Thus, if the effusion and necrotic tissue could be effectively cleared by the insertion of a subcutaneous suction drainage tube, the frequency of incisional SSIs should be drastically decreased.

Out of all the trials in the meta-analysis, only two trials showed a significant reduction in SSI incidence in the drain group.[27] Fujii et al. included high-risk patients, including emergency laparotomies, and patients with thick subcutaneous fat and the risk ratio showed a reduction in the SSI rate in the drain group (RR 0.37 (0.15–0.9)).[28] ‘Baier’ did not agree with it.[29] ‘Pan’ did his research on patients with ileostomy reversal and agreed with Fujii et al. [29] He found his patients without a drain to develop SSI at the rate of 12.5% while those with a drain at 1.2%. We found similar results in our study.

It has also been reported by Soper et al. [30] that the depth of subcutaneous fat in a patient is an

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independent risk factor for SSI. Subcutaneous drains may therefore be useful in high-risk and/or obese patients, even though this is not clear from the meta-analysis due to underpowering. In fact, two studies described the different forms of wounds in the control and drain groups. and in this study, there was an overall reduction of 34% in SSI, where a subcutaneous drain was placed.

Conclusion

Subcutaneous suction drains have been shown to lower SSI in a significant number of patients. In our study, the incidence of developing SSI was higher in co-morbid patients, patients with low hemoglobin and low albumin, emergency cases, and colon procedures. E. coli was the most frequently isolated organism, followed by Klebsiella pneumonia.

Therefore, the evaluation of these factors aids in the provision of preventative treatment to lower morbidity and death in high-risk patients.

A subcutaneous suction drainage tube allows for a faster rate of recovery and, ultimately, a shorter hospital stay, less morbidity, and quicker rehabilitation.

Therefore, when closing the abdominal wall in patients undergoing abdominal surgery, a subcutaneous suction drain should be taken into consideration.

Declaration: Study was conducted with proper code of ethics and written informed consent taken from participating patients.

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Results & Tables

Table 1: Distribution of patients according to age

Age	No-Drain		Drain	
	No.	%	No.	%
<=20 years	0	0.0	2	8.0
21-40 years	10	40.0	4	16.0
41-60 years	6	24.0	17	68.0
>60 years	9	36.0	2	8.0
Total	25	100.0	25	100.0
Mean Age	46.48 ± 19.04		46.40 ± 12.93	
't' value, df	0.017, df=48			
P value	0.986			

Unpaired 't' test applied. P value = 0.986, Not significant

Table 2: Comparison of mean hospital stay between the two groups

Group	Number	Mean ± SD	't' value, df	P value
No-Drain	25	11.64 ± 4.89	1.289, df=48	0.203
Drain	25	9.96 ± 4.29		
Total	50			

Unpaired 't' test applied. P value = 0.203, Not significant

Table 3 Distribution of patients according to comorbidities

Comorbidities	No-Drain		Drain	
	No.	%	No.	%
None	13	52.0	14	56.0
Hypertension	8	32.0	2	8.0
DM	5	20.0	7	28.0
CKD	1	4.0	1	4.0
COPD	1	4.0	0	0.0
Tuberculosis	1	4.0	1	4.0
Arthritis	0	0.0	1	4.0
Seropositivity	0	0.0	1	4.0

Table 4: Association between comorbidities and surgical site infection in No-Drain group (N=25)

Comorbidities	Surgical Site Infection		Total
	Absent	Present	
Present	5 41.7%	7 58.3%	12 100%
Absent	6 46.2%	7 53.8%	13 100%
Total	11 44.0%	14 56.0%	25 100%

Pearson chi-square test applied.

Chi-square value = 0.051, df=1, P value = 0.821, Not Significant

Table 5: Association between comorbidities and surgical site infection in Drain group(N=25)

Comorbidities	Surgical Site Infection		Total
	Absent	Present	
Present	6 54.5%	5 45.5%	11 100%
Absent	13 92.9%	1 7.1%	14 100%
Total	19 76.0%	6 24.0%	25 100%

Pearson chi-square test applied.

Chi-square value = 4.957, df=1, P value = 0.026, Significant

Table 6: Comparison of mean hospital stay between the two groups in relation to presence absence of surgical site infection

Group	Surgical Site Infection	Number	Mean ± SD	't' value, df	P value
No-Drain	Absent	11	6.82 ± 1.08	-9.393, df=23	0.001*
	Present	14	15.43 ± 2.88		
Drain	Absent	19	7.79 ± 1.27	-11.071, df=23	0.001*
	Present	6	16.83 ± 2.86		

Unpaired 't' test applied. P value <0.05 was taken as statistically significant

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Fig1

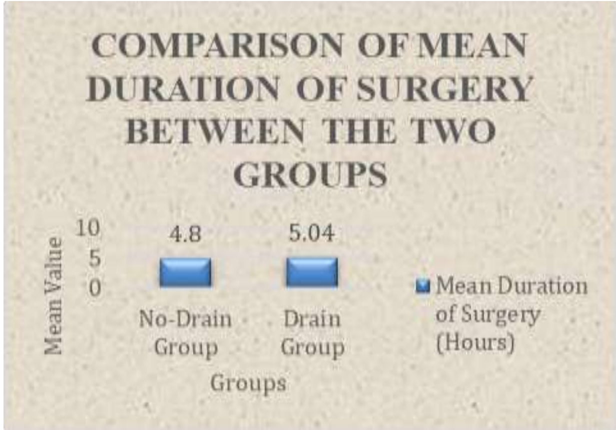

Fig2

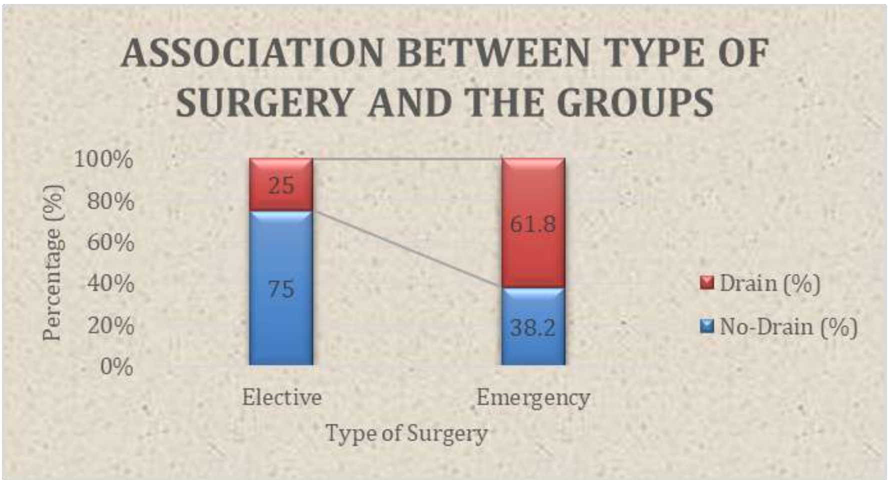

Table 7: Association between type of surgery and the groups

Type of Surgery	Group		Total
	No-Drain	Drain	
Elective	12 75%	4 25%	16 100%
Emergency	13 38.2%	21 61.8%	34 100%
Total	25 50%	25 50%	50 100%

Pearson chi-square test applied. Chi-square value = 5.882, df=1, P value = 0.015, Significant

Table 8: Comparison of mean hospital stay in relation to SSI

SSI	Number	Mean ± SD	't' value, df	P value
Absent	30	6.97 ± 1.22	-13.716, df=48	0.001*
Present	20	15.40 ± 3.03		
Total	50			

Unpaired 't' test applied. P value = 0.001, Significant

Table 9: Association between SSI and Hemoglobin level

Hemoglobin Level	SSI		Total
	Absent	Present	
<10 gm%	6 31.6%	13 68.4%	19 100%
>=10 gm%	24 77.4%	7 22.6%	31 100%
Total	30 60.0%	20 40.0%	50 100%

Pearson Chi-square test applied.

Chi-square value = 10.314, df=1, P value=0.001, Significant

Table 10: Association between SSI and Albumin level

Albumin Level (<=3)	SSI		Total
	Absent	Present	
No	25 75.8%	8 24.2%	33 100%
Yes	5 29.4%	12 70.6%	17 100%
Total	30 60.0%	20 40.0%	50 100%

Pearson Chi-square test applied.

Chi-square value = 10.042, df=1, P value=0.002, Significant

Table 11: Association between SSI and Duration of surgery >=5 hours

Duration of surgery >=5 hours	SSI		Total
	Absent	Present	
No	21 72.4%	8 27.6%	29 100%
Yes	9	12	21

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	42.9%	57.1%	100%
Total	30 60.0%	20 40.0%	50 100%

Pearson Chi-square test applied.

Chi-square value = 4.433, df=1, P value=0.035, Significant

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