DOI: 10.7860/JCDR/2026/84986.24022

Original Article

Surgery Section

Role of Subcutaneous Negative Suction Drainage in Surgical Site Infection and its Relation with Subcutaneous Fat Thickness: A Prospective Interventional Study

AMANDEEP SINGH[1], PARAMPREET SINGH SANDHU[2], ASHUTOSH TALWAR[3], JASKARAN SINGH[4], HARAMRITPAL KAUR[5], RAJVIR KANDHOLA[6]

ABSTRACT

Introduction: Wound complications are a major concern for surgeons after surgery. Surgical Site Infection (SSI) is the second most common complication. Many factors in a patient's journey through surgery have been identified as contributing to the risk of SSI. Therefore, preventing these infections is complex and requires integrating a range of preventive measures before, during, and after surgery. In countries like India, where the risk of wound infection is high due to multiple factors, the importance of novel wound care techniques is essential.

Aim: To study the role of negative suction drain in reducing SSI in exploratory Laparotomies and to study the relation of Subcutaneous Fat Thickness (SFT) with SSI.

Materials and Methods: This prospective interventional study was conducted in Guru Gobind Singh Medical College and Hospital, Faridkot, Punjab, India, from July 2021 to January 2023. A total of 80 patients who underwent emergency exploratory laparotomy were included in the study. SFT was measured at the mid-point between the umbilicus and pubic symphysis from skin up to the rectus sheath using a sterile scale. Subcutaneous negative suction drain (16 Fr) was placed between the skin and rectus sheath and labelled as Group-A (D). In Group-B (ND), the skin was closed without placing a suction drain. Signs of SSI were identified, and a comparison was done using the Chi-square test.

Results: The overall incidence of SSI in the present study was 38.75%. In 31 SSI cases, the most common were males 24 cases (77.4%) and >50 years of age 11 cases (35.5%). The incidence of SSI in the drain group (Group-A) was 17.5%, significantly lower than in the non drain group (Group-B), i.e., 60%. In Group-A (with subcutaneous negative suction drain), SSI rates remained consistently low across all higher SFT categories, with minimal variation. In contrast, Group-B (without drain) showed a sharp and progressive increase in SSI incidence with increasing SFT, reaching 91.7% in the 3.1-3.5 cm group and 100% in patients with SFT ≥3.6 cm.

Conclusion: Use of negative suction drain in emergency exploratory laparotomy cases reduces SSI or morbidity. We recommend using a subcutaneous negative-suction drain in emergency exploratory laparotomy cases with high SFT.

Keywords: Exploratory laparotomy, Non drain, Wound care, Wound complication

INTRODUCTION

Wound complications are a major concern for surgeons after surgery. Wound complications are more common in emergency surgeries than in elective procedures. Wound complications are divided into early and late. Early complications include Surgical Site Infection (SSI), haematoma, seroma formation, wound dehiscence and burst abdomen. Late complications include chronic wound pain, suture sinus and incisional hernias [1].

According to the Centres for Disease Control and Prevention (CDC) and the National Nosocomial Infections Surveillance System (NNIS), SSI is defined as infections that occur within 30 days of an operative procedure with no implant or within a year if an implant is left in place and infections appear to be related to surgery [1].

The SSI rate ranges from 2.5% to 41.9% across studies. The incidence in India (20%) is higher than in other developed countries like the United Kingdom (3.1%) and the Netherlands (4.3%) [2]. Based on surgical procedures, the incidence of SSI is higher in exploratory laparotomy (34%), followed by colon surgery (21%) [2].

Many factors have been identified as contributing to the risk of SSI. Therefore, preventing these infections is complex and requires integrating a range of preventive measures before, during, and after surgery. In addition to the extent of microbial contamination, host factors such as age, nutritional status, co-morbidities, immune competence, length of preoperative hospital stay, preoperative procedures such as skin preparation/antisepsis, antimicrobial prophylaxis, preoperative shaving, and duration, as well as operation technique, are risk factors for SSI [2].

It occurs more commonly due to abdominal cavity infection than hospital-acquired infection. The most commonly isolated organism is *Escherichia coli*, followed by *Klebsiella pneumoniae*. Other organisms are beta-haemolytic *streptococci*, *Acinetobacter*, *Aeromonas*, *Achromobacter*, *Enterococci*, *Pseudomonas* and *Bacillus* [3].

As microbes are developing resistance to antibiotics, it is difficult to find new antibiotics, so newer techniques like Negative Pressure Wound Therapy (NPWT) and Vacuum-Assisted Closure (VAC) were developed. Negative suction drains reduce the bacterial load around the wound, remove blood or fluid collections, and reduce the potential space for collections to accumulate [3]. It also improves wound healing by decreasing tissue oedema and promoting vascular supply [4].

Abdominal anatomic characteristics i.e., SFT, Rectus Abdominis Thickness (RAT), and Abdominal Depth (AD) vary from individual to individual. As the thickness of subcutaneous fat increases, it will increase the tension at the suture line, which will decrease blood supply and result in increased risk of incisional liquefaction and delayed wound healing, which further increases the risk of wound infection or SSI [5].

Several studies have shown that Body Mass Index (BMI) does not account for body fat distribution. Local SFT is a better marker than BMI for predicting SSI, especially in patients undergoing abdominal surgery [6].

There are reports in the literature suggesting that placement of a drain predisposes the area to infection and prolongs hospital stay. This may be true in clean surgeries, with a shorter hospital stay. But in emergency peritonitis cases with high morbidity, with contaminated/dirty wounds and obese patients with thick subcutaneous fat having large dead space, application of negative pressure with subcutaneous suction drain imparts a positive effect on wound healing and granulation tissue formation that results in faster healing [7].

There are very few studies that have investigated the effect of abdominal anatomic features on SSI development [4,5]. There are studies regarding the role of negative suction drain in preventing SSI, but the present study, in addition to this, also considers SFT. So, the authors conducted the present study to evaluate the role of subcutaneous negative suction drain in SSI and its relation with SFT.

MATERIALS AND METHODS

The present prospective interventional study was conducted in Guru Gobind Singh Medical College and Hospital Faridkot, Punjab, India, from July 2021 to January 2023, after clearance from the Institutional Ethical Committee (no. BFUHS/2K22p-TH/7407).

Inclusion criteria: Patients aged more than 18 years and of either sex with a confirmed diagnosis of perforation peritonitis (diagnosis confirmed with an abdominal X-ray and Contrast-Enhanced Computed Tomography (CECT) abdomen, wherever needed), patients with SFT more than 2.5 cm and patients willing to undergo surgery were included in the study.

Exclusion criteria: Patients with other co-morbidities like diabetes mellitus, hypoproteinaemia, immunocompromised, on radio or chemotherapy, which makes them prone to SSI, patients requiring emergency exploratory laparotomy for accidental or traumatic abdominal injury were excluded from the study. Patients with accidental removal of the suction drain and patients requiring re-exploration after the first surgery were excluded from the study.

A total of 80 eligible patients of either gender were included in the study using a convenience sampling technique. These patients were randomly divided into Group-A and Group-B. In Group-A (40 patients), a suction drain was inserted; in Group-B (40 patients), no drain was inserted after definitive surgery. A computer-generated random table was used to allocate participants. For analysis, SFT was stratified into categories of 2.5-3.0 cm, 3.1-3.5 cm, 3.6-4.0 cm, 4.1-4.5 cm and >4.0 cm to assess its association with outcomes.

Study Procedure

Before the procedure, the incision site was cleaned three times with 10% povidone-iodine (betadine) solution under aseptic precautions. A midline incision was made while preserving the umbilicus. The SFT was measured at the midpoint between the umbilicus and the pubic symphysis, extending from the skin surface up to the rectus sheath, using a sterile measuring scale. After completion of the surgical procedure, the abdomen was closed in two layers. A 16 Fr subcutaneous negative suction drain was placed between the skin and rectus sheath in half of the patients and secured with 2-0 silk cutting suture; these patients were categorised as Group-A. In the remaining patients (Group-B), the skin was closed without placement of a suction drain. Finally, an antiseptic dressing was applied over the incision site.

Postoperatively, the surgical wound was examined daily for signs of discharge, redness, or other features of inflammation. Antiseptic dressing was performed daily after cleaning the wound and drain site with 10% povidone-iodine solution. In patients with a subcutaneous negative suction drain, the drain output was measured every 24 hours, and the drain was removed once the 24-hour output was less than 20 mL.

Post-procedure analysis was conducted to assess early postoperative complications, particularly SSI. SSI was defined based on the presence of one or more of the following criteria: purulent drainage from the incision with or without laboratory confirmation; organisms isolated from an aseptically obtained culture of fluid or tissue from the incision; at least one clinical sign of infection such as pain or tenderness, localised swelling, redness, or heat requiring deliberate opening of the superficial incision by a surgeon (unless the culture was negative); or diagnosis of superficial SSI made by the surgeon or attending physician. All patients were followed up for 30 days postoperatively for the occurrence of SSI or any other wound-related complications.

STATISTICAL ANALYSIS

Statistical testing was conducted with the Statistical Package for the Social Sciences (SPSS) version 17.0. Continuous variables were presented as mean ± SD. Categorical variables were expressed as frequencies and percentages. Categorical data between the groups were compared using the Chi-square test and the Fisher's-exact test. A p-value less than 0.05 was taken to indicate a significant difference.

RESULTS

Both groups were comparable in terms of age and gender distribution [Table/Fig-1,2].

Age group (in years)	Group-A n (%)	Group-B n (%)	Total No. of cases	χ^2	p-value
< 20	1 (2.5%)	4 (10%)	5	5.338	0.254
21-30	9 (22.5%)	11 (27.5%)	20		
31-40	6 (15%)	6 (15%)	12		
41-50	15 (37.5%)	7 (17.5%)	22		
> 50	9 (22.5%)	12 (30%)	21		
Total	40	40	80		

[Table/Fig-1]: Age group distribution.

Drain		Group-A(D) n (%)	Group-B(ND) n (%)	Total	χ^2	p-value
Sex	Female	15 (37.5%)	6 (15.0%)	21	5.23	0.022
	Male	25 (62.5%)	34 (85.0%)	59		
Total		40 (100.0%)	40 (100.0%)	80		

[Table/Fig-2]: Group-wise distribution according to sex.
p-value ≤0.05 is significant, >0.05 is insignificant

In the present study, minimum SFT group of 2.5-3 cm had maximum number of 29 (36.3%) cases; and maximum SFT group >4.5 cm had 11 (13.8%) cases [Table/Fig-3].

	Drain	Group-A (D) n (%)	Group-B (ND) n (%)	Total	χ^2	p-value
SFT Group (in cm)	2.5-3	11 (27.5%)	18 (45.0%)	29	7.767	0.101
	3.1-3.5	10 (25.0%)	12 (30.0%)	22		
	3.6-4.0	7 (17.5%)	6 (15.0%)	13		
	4.1-4.5	5 (12.5%)	0	5		
	>4.5	7 (17.5%)	4 (10.0%)	11		
Total		40 (100.0%)	40 (100.0%)	80		

[Table/Fig-3]: Case distribution as per SFT.
p-value ≤0.05 Is significant, >0.05 is insignificant.

In the present study, out of total 80 cases, 31 (38.75%) had SSI and 49 (61.25%) had no signs of SSI. So, the incidence of SSI in the present study is 38.75%. In the present study, out of 40 patients in Group-A, 7 (17.5%) had SSI, which was much less than the 24 (60%) cases of SSI in Group-B. [Table/Fig-4].

In Group-A, of 11 cases of SFT 2.5-3 cm, 5 (45.50%) had SSI; only one case of SSI was detected in each SFT group of 3.1-3.5 cm and >4.5 cm [Table/Fig-5].

Drain		Group-A (D) n (%)	Group-B (ND) n (%)	N	χ^2	p-value
Surgical site infection	Absent	33 (82.5%)	16 (40.0%)	49	15.221	0.001
	Present	7 (17.5%)	24 (60.0%)	31		
Total		40 (100.0%)	40 (100.0%)	80		

[Table/Fig-4]: Relationship between SSI and subcutaneous negative suction drain.
p-value ≤0.05 is significant

Group-A			Surgical Site Infection (SSI)		Total	χ^2	p-value
			Absent n (%)	Present n (%)			
Group-A	SFT Group	2.5-3	6 (54.5%)	5 (45.5%)	11	8.939	0.063
		3.1-3.5	9 (90.0%)	1 (10.0%)	10		
		3.6-4.0	7 (100.0%)	0	7		
		4.1-4.5	5 (100.0%)	0	5		
		>4.5	6 (85.7%)	1 (14.3%)	7		
	Total		33 (82.5%)	7 (17.5%)	40		

[Table/Fig-5]: Relation between SFT and SSI in Group-A.
p-value ≤0.05 is significant, >0.05 is insignificant

In the present study, in Group-B, out of 18 patients in SFT group <3.1 cm, only 3 (16.7%) had SSI. This showed that in Group-B, SSI increased significantly with increase in SFT [Table/Fig-6].

Group-B			Surgical Site Infection (SSI)		Total	χ^2	p-value
			Absent n (%)	Present n (%)			
Group	SFT Group	2.5-3	15 (83.3%)	3 (16.7%)	18	25.764	0.001
		3.1-3.5	1 (8.3%)	11 (91.7%)	12		
		3.6-4.0	0	6 (100.0%)	6		
		4.1-4.5	0	0	0		
		>4.5	0	4 (100.0%)	4		
	Total		16 (40.0%)	24 (60.0)	40		

[Table/Fig-6]: Relation between SFT and SSI in Group-B.
p-value ≤0.05 is significant.

In Group-A (with subcutaneous negative suction drain), SSI rates remained consistently low across all higher SFT categories, with minimal variation. In contrast, Group-B (without drain) showed a sharp and progressive increase in SSI incidence with increasing SFT, reaching 91.7% in the 3.1-3.5 cm group and 100% in patients with SFT ≥3.6 cm [Table/Fig-7].

SFT Group (in cm)	Group-A SSI present n (%)	Group-B SSI present n (%)	p-value
2.5-3	5 (45.5%)	3 (16.7%)	0.18
3.1-3.5	1 (10.0%)	11 (91.7%)	<0.001
3.6-4.0	0	6 (100%)	0.001
>4.5	1 (14.3%)	4 (100%)	0.02

[Table/Fig-7]: Association between Subcutaneous Fat Thickness (SFT) and Surgical Site Infection (SSI) in Group-A and Group-B.
No patients were present in Group-B with SFT of 4.1-4.5 cm, hence no p-value was determined; Fisher's-exact test

In the present study, out of 40 cases of Group-A, maximum cases 20 (50%) were having hospital stay of <14 days. But in Group-B, out of 40 cases, maximum cases 17 (42.5%) were having hospital stay of >21 days [Table/Fig-8].

In the present study, out of 31 patients of SSI, 13 (41.9%) were admitted in ICU and out of 49 cases without SSI, 10 (20.4%) were admitted in ICU. This showed that ICU admission was more common in SSI patients.

	Drain	Group-A (D) n (%)	Group-B (ND) n (%)	Total	χ^2	p-value
Hospital Stay GP (in days)	<14	20 (50.0%)	14 (35.0%)	34	4.727	0.094
	14-21	12 (30.0%)	9 (22.5%)	21		
	>21	8 (20.0%)	17 (42.5%)	25		
	Total	40 (100.0%)	40 (100.0%)	80		

[Table/Fig-8]: Distribution of cases as per hospital stay.
p-value ≤0.05 is significant, >0.05 is insignificant.

In present study, 49 (61.25%) cases had no growth, *Escherichia Coli* present in 20 (25%) cases followed by *Staphylococcus aureus* in 7 (8.75%) cases, *Klebsiella* in 3 (3.75%) cases and *Enterococcus* in 1 (1.25%) case.

DISCUSSION

The SSI is the most frequent type of healthcare-associated infection in low and middle-income countries. In the present study, the mean age was 42.02±15.97. The mean age and standard deviation in Harish R et al., Mathews MZ et al., and Kagita R et al., were 40.94±15.1, 43.2±14.2 and 43.72±15.56, respectively [8-10]. In the present study, females were 21 (26.25%), and males were 59 (73.75%). Thus, exploratory laparotomy is predominantly done in males. Mathews MZ et al., also showed that laparotomy was more commonly done in males [9].

The present study shows that out of the total 80 cases, 31 (38.75%) had SSI and 49 (61.25%) had no signs of SSI. So, the incidence of SSI in the present study is 38.75%. The overall incidence of SSI in the studies done by Alkaaki A et al., on SSI after abdominal surgeries was 16.3% [11]. Kagita R et al., on subcutaneous negative pressure versus simple closure of skin incisions following an emergency laparotomy was 39.47% [10]. This variation results from various factors that affect SSI. The incidence of SSI in the present study is comparable to that in these studies.

Harish R et al., compared the incidence of SSI in elective and emergency surgery. The incidence of SSI in elective cases was 14.89%, and in emergency cases was 39.62%. The present study was conducted only in emergency exploratory laparotomy, and the incidence was 38.75%, which is very close to the incidence in emergency cases [8].

In the present study, 49 (61.25%) cases had no growth, *Escherichia coli* was present in 20 (25%) cases, followed by *Staphylococcus aureus* in 7 (8.75%) cases, *Klebsiella* in 3 (3.75%) cases, and *Enterococcus* in 1 (1.25%) case. As per Kumar S et al., the most common organism causing SSI was *Escherichia coli*, accounting for 62.5% and 62.7% of cases in the drain group and control group, respectively, followed by *Klebsiella* (12.5% vs 24.14%) [7].

In the present study, in Group-B, SSI increased significantly with increasing SFT. In the study by Teppa R et al., the incidence of SSI was higher when TSF >2.5 cm than when Thickness of Subcutaneous Fat (TSF) <2.5 cm [6]. Nakagawa H et al., suggested SFT as an independent risk factor for SSI in colorectal surgery [12]. Studies by Fujii T et al., and Tongyoo A et al., also examined SFT and SSI, revealing that SSI incidence was positively associated with subcutaneous abdominal wall thickness in colorectal surgery [13,14].

In the present study, hospital stay decreases with the use of a subcutaneous negative-suction drain. Harish R et al., observed that the mean duration of stay for patients in the case group (i.e., with a suction drain) was 8.84±2.85 days, and for patients in the control group (i.e., non-suction drain) was 11.2±4.85 days [8].

From the present study, the authors concluded that the use of a subcutaneous negative-suction drain reduces the risk of SSI in emergency exploratory laparotomy cases.

Limitation(s)

The present study was conducted at a single centre with a limited sample size, which may restrict the generalisability of the findings. Further multicentre studies with larger sample sizes are required to validate these results. Important confounding variables, such as BMI, diabetes status, nutritional status, duration of surgery, and intraoperative blood loss, were not controlled for or adjusted for, which may have influenced SSI outcomes. Variability in measuring SFT (e.g., intraoperative vs. radiological assessment, interobserver variation) may introduce measurement bias.

CONCLUSION(S)

From the present study, the authors concluded that the use of a subcutaneous negative-suction drain reduces the risk of SSI in emergency exploratory laparotomy cases.

REFERENCES

[1] Ramani PA, Kiran SU, Deevi MM, Reddy GVS, Saichand G, Yeeli SS, et al. Prevalence of surgical site infections and their sensitivity patterns in elective abdominal surgeries in King George Hospital, Visakhapatnam. Int Surg J. 2020;7(7):2247-50.
[2] Setty NH, Nagaraja MS, Nagappa DH, Giriyaiah CS, Gowda NR, Naik RD. A study on Surgical Site Infections (SSI) and associated factors in a government tertiary care teaching hospital in Mysore, Karnataka. Int J Med Public Health. 2014;4(2):171-75.
[3] Cooper RA. Surgical site infections: Epidemiology and microbiological aspects in trauma and orthopaedic surgery. Int Wound J. 2013;10(Suppl 1):03-08.
[4] Arer IM, Yabanoglu H, Aytac HO, Ezer A. The effect of subcutaneous suction drains on surgical site infection in open abdominal surgery: A prospective randomized study. Ann Ital Chir. 2016;87(1):49-55.
[5] Liu S, Wang M, Lu X, Feng M, Wang F, Zheng L, et al. Abdomen depth and rectus abdominis thickness predict surgical site infection in patients receiving elective radical resections of colon cancer. Front. Oncol. 2019;9(637):01-06.
[6] Teppa R, Sude NS, Karanam VPK, Mallipudi BVP. Relevance of subcutaneous fat thickness as a risk factor for surgical site infections in abdominal surgeries. Cureus. 2022;14(1):01-09.
[7] Kumar S, Chatterjee S, Gupta S, Satpathy S, Ray U. Role of subcutaneous closed vacuum drain in preventing surgical site infection in emergency surgery for perforative peritonitis: A randomised control study. Bangladesh J Med Sci. 2017;16(1):85-90.
[8] Harish R, Kazi FN, Sharma JVP. Efficacy of subcutaneous closed suction drain in the reduction of postoperative surgical site infection. Surg J. 2021;7(4):275-80.
[9] Mathews MZ, Subramanyam SG, Mitta N. A prospective study in peritonitis patients to compare the impact of subcutaneous negative suction closure, conventional primary closure of skin and subcutaneous tissue and open skin technique following laparotomy. Int Surg J. 2019;6(9):3293-96.
[10] Kagita R, Mulla SA, Pai BS, Desai M. Subcutaneous negative pressure versus simple closure of skin incision following an emergency laparotomy: A randomised control study. Int Surg J. 2019;6(4):1230-37.
[11] Alkaaki A, AlRadi O, Khoja M, Alnawawi A, Maghrabi A, Altaf A, et al. Surgical site infection following abdominal surgery: A prospective cohort study. Can J Surg. 2019;62(2):111-17.
[12] Nakagawa H, Ohno K, Ikeda S, Muto M. The effect of preoperative subcutaneous fat thickness on surgical site infection risk in patients undergoing colorectal surgery: Results of a multisite, prospective cohort study. Ostomy Wound Management. 2016;62(8):14-20.
[13] Fujii T, Tsutsumi S, Matsumoto A, Fukasawa T, Tabe Y, Yajima R, et al. Thickness of subcutaneous fat as a strong risk factor for wound infections in elective colorectal surgery: Impact of prediction using preoperative CT. Dig Surg. 2010;27(4):331-35.
[14] Tongyoo A, Chatthamrak P, Sriussadaporn E, Limpavitayaporn P, Mingmalairak C. Risk assessment of abdominal wall thickness measured on pre-operative computerized tomography for incisional surgical site infection after abdominal surgery. J Med Assoc Thai. 2015;98(7):677-83.

PARTICULARS OF CONTRIBUTORS:
1. Professor, Department of General Surgery, GGSMCH, Faridkot, Punjab, India.
2. Assistant Professor, Department of General Surgery, GGSMCH, Faridkot, Punjab, India.
3. Associate Professor, Department of General Surgery, GGSMCH, Faridkot, Punjab, India.
4. Senior Resident, Department of General Surgery, GGSMCH, Faridkot, Punjab, India.
5. Professor, Department of Anaesthesia, GGSMCH, Faridkot, Punjab, India.
6. Assistant Professor, Department of Anaesthesia, GGSMCH, Faridkot, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Parampreet Singh Sandhu,
H. No. 14, Village Jandwala, Faridkot-151212, Punjab, India.
E-mail: param181092@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
• Plagiarism X-checker: Oct 28, 2025
• Manual Googling: Apr 16, 2026
• iThenticate Software: Apr 18, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
• Financial or Other Competing Interests: None
• Was Ethics Committee Approval obtained for this study? Yes
• Was informed consent obtained from the subjects involved in the study? Yes
• For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Oct 19, 2025**
Date of Peer Review: **Jan 13, 2026**
Date of Acceptance: **Apr 21, 2026**
Date of Publishing: **Aug 01, 2026**