RESEARCH PAPER

Comparison of Surgical Site Infection Rates Following Laparotomy for Peritonitis: Closed Wound With Drain Versus Open Wound Without Drain

Muhammad Ammar Bashir [1]*, Nakash Ahsan [2], Rashid Mehmood [3], Ivon Ijaz Bhatti [4], Aamer Wadud [5], Hafiz Hamyoun Khan [6]

[1] FCPS General Surgery Senior Registrar Surgery Islam Teaching Hospital Sialkot
[2] FCPS General Surgery Senior Registrar Surgery Surgical Unit 8 Gujranwala Medical College Teaching Hospital
[3] FCPS General Surgery Medical Officer Surgical Department THQ Daska
[4,5] Assistant Professor,HITEC Institute of Medical Sciences and HIT Hospital, Taxilla
[6]MBBS, House Officer Internal Medicine Shaikh Zayed Hospital, Lahore

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ABSTRACT

Background: Surgical site infection (SSI) is a common complication following laparotomy for peritonitis, significantly increasing morbidity, hospital stay, and healthcare burden. The choice of wound management technique, particularly closed wound with drain versus open wound without drain, remains a subject of clinical debate.

Objectives: To compare the frequency of surgical site infection following laparotomy for peritonitis between closed wound with drain and open wound without drain techniques.

Study Design & Setting: This was a comparative study conducted at the Department of General Surgery of Islam Teaching Hospital Sialkot over a period of six months

Methodology: A total of 120 patients with peritonitis undergoing emergency laparotomy were included and divided into two groups of 60 patients each. Group A underwent primary wound closure with placement of a subcutaneous drain, while Group B had open wound management without drain. Patients were followed for 30 days postoperatively to assess the occurrence of SSI. Data were analyzed using SPSS version 25.0, and chi-square test was applied with $p \leq 0.05$ considered significant.

Results: The mean age of patients was comparable between both groups. SSI was observed in 23.3% of patients in Group A and 15.0% in Group B, with no statistically significant difference ($p = 0.248$). Hospital stay was significantly longer in Group B (10.35 ± 3.10 days) compared to Group A (8.90 ± 2.75 days, $p = 0.006$). Multivariable analysis showed that diabetes mellitus (AOR = 2.84, $p = 0.047$), severe contamination (AOR = 3.15, $p = 0.029$), and prolonged hospital stay (AOR = 2.67, $p = 0.042$) were significantly associated with SSI.

Conclusion: Both wound management techniques demonstrated comparable SSI rates, while patient-related factors played a more significant role in infection risk.

Keywords: Laparotomy, Peritonitis, Surgical site infection, Wound closure, Wound management

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INTRODUCTION

Surgical site infection (SSI) is a significant postoperative complication defined as an infection occurring at or near the surgical incision within 30 days of an operative procedure. It remains a major contributor to postoperative morbidity, prolonged hospital stay, and increased healthcare costs, particularly in patients undergoing emergency laparotomy for peritonitis.[1] Peritonitis, characterized by inflammation of the peritoneal cavity due to contamination by gastrointestinal contents, often necessitates urgent surgical intervention, where optimal wound management plays a critical role in determining outcomes.[2,3] Globally, SSI rates vary widely, ranging from 2% to 20% in general surgical procedures, with substantially higher rates reported in contaminated and dirty surgeries such as laparotomy for peritonitis.[4] In low- and middle-income countries, including Pakistan, the burden is even greater due to limited resources, delayed presentations, and higher prevalence of risk factors. It has reported SSI rates exceeding 30% in such settings, emphasizing the need for effective preventive strategies.[5]

The development of SSI is multifactorial, involving patient-related, microbial, and procedural factors. Common risk factors include advanced age, malnutrition, diabetes mellitus, anemia, and immunosuppression, along with intraoperative factors such as prolonged surgery, inadequate aseptic technique, and degree of contamination. The method of wound closure and the use or omission of surgical drains are also considered

**Author for Correspondence: ammarbashir179@gmail.com*

important determinants influencing infection rates.[6] The pathophysiology of SSI involves bacterial contamination of the surgical wound, followed by colonization and proliferation when host defense mechanisms are compromised.[7] In peritonitis, the high bacterial load, presence of necrotic tissue, and inflammatory exudates create an environment conducive to infection. Impaired local perfusion and tissue hypoxia further hinder immune response and wound healing.[8]

Clinically, SSI may present with localized signs such as erythema, warmth, swelling, pain, and purulent discharge from the incision site, along with systemic features including fever and leukocytosis. If not promptly managed, it may lead to wound dehiscence, intra-abdominal abscess formation, sepsis, and increased mortality.[9] Diagnosis is primarily clinical, supported by laboratory findings and microbiological cultures of wound discharge. Imaging may be required in suspected deep or organ-space infections to assess the extent and guide management.[10]

Current management strategies focus on infection prevention through appropriate antibiotic prophylaxis, strict aseptic techniques, and optimal surgical practices. Wound management approaches in contaminated surgeries include primary closure with or without drains, delayed primary closure, and healing by secondary intention. The use of subcutaneous drains aims to prevent fluid accumulation, whereas leaving the wound open is thought to reduce bacterial proliferation.[11,12]

Existing literature presents varying outcomes regarding the superiority of closed wound with drain versus open wound without drain techniques. While some studies suggest that drains reduce SSI by preventing fluid collection, others report no significant benefit or even increased infection risk due to foreign body presence. Similarly, open wound management may decrease infection rates but is associated with delayed healing and patient discomfort. These inconsistencies highlight the ongoing debate regarding the optimal wound management strategy in laparotomy for peritonitis.

MATERIALS AND METHODS

This comparative study was conducted in the Department of General Surgery of Islam Teaching Hospital Sialkot over a period of six months from August 2025 to September 2025 to February 2026. A total of 120 patients diagnosed with peritonitis and undergoing emergency laparotomy were included using a non-probability consecutive sampling technique. The sample size of 120 patients was calculated using the WHO sample size calculator, taking an anticipated proportion of surgical site infection of 30%, a 95% confidence level, and a margin of error of 8%. The calculated sample size was approximately 108, which was increased to 120 to improve study power and account for possible dropouts.

Patients aged between 18 to 65 years of either gender, presenting with clinical and radiological evidence of peritonitis requiring laparotomy, were included in the study. Patients with immunocompromised status, pre-existing wound infection, history of previous abdominal surgery within the last 30 days, or those lost to follow-up were excluded. After obtaining informed consent, patients were randomly allocated into two equal groups of 60 patients each using a lottery method. In Group A, the abdominal wound was closed primarily with placement of a subcutaneous drain, while in Group B, the wound was left open without placement of a drain to heal by secondary intention.

All patients received standardized perioperative care, including intravenous antibiotics, fluid resuscitation, and appropriate surgical management of the underlying cause of peritonitis. Surgical procedures were performed under general anesthesia following standard aseptic protocols. Postoperatively, patients were monitored for signs of surgical site infection, including redness, swelling, discharge, pain, and fever, during hospital stay and on follow-up up to 30 days.

Data were recorded on a pre-designed proforma, including demographic details, clinical findings, operative notes, and postoperative outcomes. The primary outcome was the frequency of surgical site infection in both groups. Data were entered and analyzed using SPSS version 25.0. Quantitative variables such as age were presented as mean and standard deviation, while qualitative variables such as gender and presence of SSI were expressed as frequency and percentage. The chi-square test was applied to compare SSI rates between the two groups, and a p-value of ≤ 0.05 was considered statistically significant

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RESULTS

The demographic profile of the study population showed that the mean age in Group A was 41.25 ± 12.38 years, while in Group B it was 39.80 ± 11.95 years, with no statistically significant difference between the groups ($p = 0.482$). The comparison of hospital stay demonstrated that patients in Group B had a longer mean duration of hospitalization (10.35 ± 3.10 days) compared to Group A (8.90 ± 2.75 days), and this difference was statistically significant ($p = 0.006$), indicating prolonged recovery in the open wound group. Similarly, gender distribution was comparable, with males constituting 63.3% in Group A and 60.0% in Group B ($p = 0.709$) as given in Table 1

Table 1: Demographic Characteristics of Patients (n = 120)

Variable	Group A (Closed Wound with Drain)	Group B (Open Wound without Drain)	p-value
Age (years)	41.25 ± 12.38	39.80 ± 11.95	0.482
Gender			
Male	38 (63.3%)	36 (60.0%)	0.709
Female	22 (36.7%)	24 (40.0%)	
Hospital Stay	8.90 ± 2.75	10.35 ± 3.10	0.006

The distribution of etiological factors of peritonitis was similar in both groups, with perforated appendix being the

most common cause (30.0% in Group A vs 33.3% in Group B), followed by duodenal and ileal perforations. No statistically significant difference was observed between the groups in terms of underlying etiology (p = 0.811), reflecting comparable baseline disease patterns, as given in Table 2.

Table 2: Distribution of Etiology of Peritonitis

Etiology	Group A (n=60)	Group B (n=60)	p-value
Perforated Appendix	18 (30.0%)	20 (33.3%)	0.811
Duodenal Perforation	15 (25.0%)	14 (23.3%)	
Ileal Perforation	12 (20.0%)	11 (18.3%)	
Typhoid Perforation	9 (15.0%)	8 (13.3%)	
Others	6 (10.0%)	7 (11.7%)	

The overall frequency of surgical site infection (SSI) was higher in Group A (23.3%) compared to Group B (15.0%); however, this difference was not statistically significant (p = 0.248). The majority of patients in both groups did not develop SSI, suggesting relatively similar outcomes between the two wound management strategies, as given in figure 1.

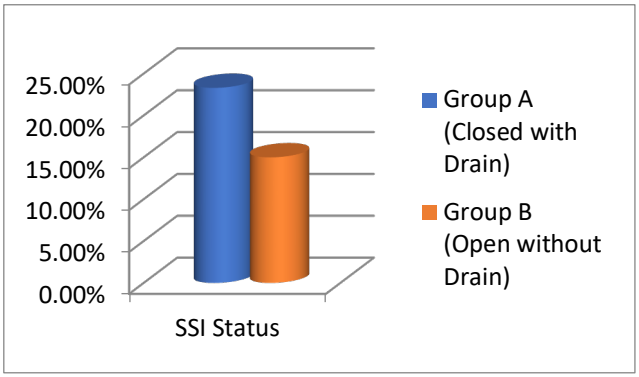

Figure 1: Frequency of Surgical Site Infection (SSI)

Analysis of SSI across different age groups showed that the highest proportion of infections occurred in patients aged 36–50 years (43.5%), followed by those aged 18–35 years (30.4%) and 51–65 years (26.1%). However, no statistically significant association was found between age groups and SSI occurrence (p = 0.462). Stratification of SSI with respect to gender revealed that males had a slightly higher proportion of SSI (65.2%) compared to females (34.8%), although this difference was not statistically significant (p = 0.701). This indicates that gender was not a significant determinant of SSI occurrence in this study population, as given in Table 3.

Table 3: Stratification of SSI with Respect to Age & Gender

Gender	SSI Present (n=23)	SSI Absent (n=97)	p-value
18–35	7 (30.4%)	38 (39.2%)	0.462
36–50	10 (43.5%)	36 (37.1%)	
51–65	6 (26.1%)	23 (23.7%)	
Male	15 (65.2%)	59 (60.8%)	0.701
Female	8 (34.8%)	38 (39.2%)	

Multivariable analysis showed that wound type was not significantly associated with SSI (AOR = 1.73, p = 0.252). However, diabetes mellitus (AOR = 2.84, p = 0.047), severe contamination (AOR = 3.15, p = 0.029), and prolonged hospital stay (AOR = 2.67, p = 0.042) were significantly associated with increased odds of SSI. Other variables such as age, gender, and duration of surgery did not show statistically significant associations, as given in Table 4.

Table 4: Multivariable Analysis of Factors Associated with Surgical Site Infection (SSI) (n = 120)

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Wound Type (Closed with Drain vs Open without Drain)	1.73	0.68 – 4.41	0.252
Age (>40 years)	1.58	0.62 – 4.01	0.335
Male Gender	1.21	0.47 – 3.12	0.689
Diabetes Mellitus	2.84	1.01 – 7.96	0.047
Duration of Surgery (>2 hours)	2.36	0.89 – 6.21	0.084
Contamination Level (Severe vs Moderate)	3.15	1.12 – 8.87	0.029
Hospital Stay (>9 days)	2.67	1.03 – 6.91	0.042

DISCUSSION

Surgical site infection (SSI) remains a common and serious complication following laparotomy for peritonitis, contributing to increased morbidity and prolonged hospital stay. Optimal wound management strategies, including closure techniques and the use of drains, play a crucial role in reducing infection risk.[13,14] However, variability in clinical practices persists due to inconsistent evidence regarding the most effective approach.

In the present study, the overall frequency of surgical site infection (SSI) was 23.3% in the closed wound with drain group and 15.0% in the open wound without drain group, with no statistically significant difference (p = 0.248). These findings contrast with Nawab et al. (2025), who reported a significantly lower SSI rate in the drain group (10.0%) compared to the no-drain group (20.83%) (p = 0.020).[15] Similarly, Mallaiah et al. (2025) observed a lower SSI rate with drains (16.67%) compared to without drains (26%), along with a significant reduction in wound

discharge (16% vs 43%, p = 0.024) and absence of seroma formation (0% vs 16.7%).[16] In contrast, the findings of Hussain et al. (2020) are more consistent with the current study, where SSI rates were 15% in the drain group and 20% in the no-drain group, with no statistically significant difference (p > 0.05), suggesting that the benefit of drain placement may not be universally reproducible.

The mean age in the present study (41.25 ± 12.38 years vs 39.80 ± 11.95 years) was comparable to Nawab et al. (40.98 ± 8.81 years), indicating similar patient demographics, although Hussain et al. reported a relatively younger population (32.02 ± 9.56 years).[15] The overall SSI rate observed in this study (19.1%) lies close to the 17.5% reported by Hussain et al. and the 20% reported by Abd Elmonim et al. (2021),[20] but is lower than the 35% reported in the cross-sectional study by Prakash (2025), where emergency laparotomy cases had a markedly higher SSI rate of 46.7% compared to 23.3% in elective procedures (p = 0.004). These variations may be attributed to differences in patient selection, contamination severity, and perioperative care practices.[19]

Risk factor analysis in the present study demonstrated that diabetes mellitus (AOR = 2.84, p = 0.047), severe contamination (AOR = 3.15, p = 0.029), and prolonged hospital stay (AOR = 2.67, p = 0.042) were significantly associated with SSI, which is in strong agreement with Garale et al. (2025) and Prakash (2025), both of whom identified diabetes, contamination, and prolonged surgical duration (p = 0.021) as significant predictors.[19] Furthermore, the lack of significant association between gender and SSI in this study aligns with Garale et al., who reported SSI rates of 17.83% in males and 15.27% in females without statistical significance.[17,18]

Interestingly, while most previous studies demonstrated a protective effect of drains in reducing SSI, the present study did not show a statistically significant advantage, despite a numerically higher SSI rate in the drain group (23.3% vs 15.0%). This discrepancy may be explained by differences in surgical technique, postoperative wound care, bacterial load, or the possibility that drains themselves may act as a foreign body facilitating infection. Additionally, the significantly longer hospital stay observed in the open wound group (10.35 ± 3.10 vs 8.90 ± 2.75 days, p = 0.006) suggests a trade-off between infection control and wound healing time. Overall, the findings of this study support the notion that while wound management technique may influence SSI rates, patient-related and disease-related factors such as diabetes and contamination level play a more critical role, which is consistently supported across the literature

STUDY LIMITATIONS

This study was conducted at a single center with a relatively limited sample size, which may affect the generalizability of the findings. Short follow-up duration may have underestimated late-onset surgical site infections. Additionally, potential confounding factors such as variations in surgical technique and postoperative care could not be fully controlled.

CONCLUSION

The frequency of surgical site infection was comparable between closed wound with drain and open wound without drain techniques. Certain factors such as diabetes mellitus and degree of contamination were significantly associated with increased risk of SSI. Both approaches may be considered viable, with outcomes influenced more by patient and disease-related factors than wound closure method alone.

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