

FREQUENCY OF SURGICAL SITE INFECTION FOLLOWING PRIMARY CLOSURE IN PATIENTS WITH ENTERIC PERFORATION: A CASE SERIES

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ABSTRACT

OBJECTIVES

This study aimed to determine the frequency of surgical site infection (SSI) following primary closure in patients presenting with enteric perforation and to evaluate the association of age and gender with SSI.

METHODOLOGY

This descriptive case series was conducted in the Department of General Surgery, Lady Reading Hospital, Peshawar, from June 2024 to March 2025. A total of 273 patients aged 18-60 years undergoing emergency laparotomy for enteric perforation were included through consecutive sampling. Patients with diabetes mellitus, uremia, obesity, secondary gut leaks, or steroid intake were excluded to control confounders. Surgical site infections were assessed on the 7th postoperative day based on clinical features and confirmed by culture. Data were analyzed in SPSS 10.0. Mean $\pm$ SD was calculated for continuous variables, while frequencies and percentages were used for categorical variables. A chi-square test was applied, with $p < 0.05$ considered statistically significant.

RESULTS

The mean age of the patients was 36.61 ± 10.16 years, with the majority (42.12%) falling within the 31–40 years age group. Overall, 107 patients (39.19%) developed SSI. No mortality was reported. Stratified analysis showed no statistically significant association between SSI and gender ($p = 0.681$) or age group ($p = 0.705$).

CONCLUSION

A high frequency of SSI was observed following primary closure in enteric perforation. Neither age nor gender was significantly associated with SSI, indicating that other factors, such as contamination level, surgical technique, and perioperative management, may play a more critical role. Consideration of delayed primary closure and strict infection-control measures may help reduce SSI in these high-risk cases.

KEYWORDS: Surgical Wound Infection, Enteric Perforation, Primary Closure, Laparotomy, Risk Factors, Postoperative Complications

INTRODUCTION

Infections that occur in wounds created by an incision over the skin are called surgical site infections (SSIs). Surgical site infections are the most common cause of healthcare-associated infections. Wound infection remains a significant postoperative morbidity and accounts for almost a quarter of the total number of nosocomial infections.¹ A small bowel perforation is still one of its fatal complications in the underdeveloped and even the developing world.^{2,3} The common site for such perforation is the terminal ileum. In literature, the reported frequency of enteric perforation ranges from 0.8% to 18%.⁴ The increasing incidence of typhoid fever with enteric perforation in our country is alarming, and almost all cases occur in an emergency setting. Various treatment options have been described in the literature for such situations, with varying results.

Some advocate for the primary closure of the perforation followed by peritoneal wash, while others have found resection-anastomosis to yield better results in terms of reduced morbidity.^{5,6} On the other hand, some researchers actually condemned the practice of stoma formation for typhoid perforation for its tendency to cause SSIs.⁷ Even the technique of surgical repair of the perforations due to typhoid enteritis has been correlated with different frequencies of surgical site infection. Ibrahim et al. reported that the double-layer closure of the primary perforation site resulted in a higher frequency of SSI compared to single-layer closure of the perforated site (47.3% vs 20.3%).⁸ As experienced so far, exteriorization in some form is often more feasible. According to Hassan F et al., when the perforation itself was exteriorized, SSI was observed to be 50% (13/26). In the other group, when the perforation was primarily closed and the proximal

healthy portion was brought out as a loop ileostomy, SSI was 35% (7/20).⁹ Ashraf et al. reported that among 100 patients with primary repair of enteric perforation, the incidence of wound infection was 23%, followed by fecal fistula at 14%, while others included wound dehiscence, leakage, and septicemia. Mortality rate was 6% in this study.¹⁰ In another study conducted by Shrivastava D, et al. (76.77%), patients had postoperative complications, with the most common complication being the surgical site infection. The median hospital stay was 21.56 days. Patients who had postoperative complications stayed longer in the hospital. In this study, the mortality rate was 15.48%.¹¹ The objective of the current study was to study these two important entities, i.e., surgical site infections and enteric perforation in relation to each other. By determining the frequency of surgical site infection in such cases in our setup, and highlighting the common factors leading to it among patients undergoing emergency laparotomy in enteric perforation, this would help us in reducing the extra disease burden of SSI on an already common problem in our community, thus reducing the avoidable morbidity and mortality in an already complicated condition as no such study had been conducted in our population for the last five years so this study has provided us the latest and updated information regarding frequency of surgical site infection in primary closure in patients presenting with enteric perforation.

METHODOLOGY

This is a descriptive case series. It is conducted at the Department of General Surgery, Lady Reading Hospital, Peshawar, from June 2024 to March 2025. The sample size was 273, based on a 23% proportion of SSI in patients' enteric perforations,¹⁰ a 95% confidence interval, and a 5% margin of error, as calculated using the WHO sample size formula. The sampling technique used was consecutive (non-probability) sampling. All the patients presenting with enteric perforation between 18 and 60 years were included. Postoperative cases with secondary gut leak diagnosed on clinical examination, Patients with confounding factors like preoperative diabetes (fasting glucose of > 126mg/dl), preoperative uremia (blood urea nitrogen level of >20mg/dl OR creatinine level >2mg/dl) and obesity (body mass index of >30kg/m²) and Patients with history of intake of steroids were excluded from the study. The aforementioned conditions act as confounding factors and, if included, would have introduced bias into the study results. The study was conducted after approval from the hospital's ethical and research committee. All patients meeting the inclusion criteria, admitted either via OPD or the emergency department, but operated in

the emergency department with laparotomy for enteric perforation, were included in the study. The purpose, risks, and benefits of the study were explained to all included patients. They were assured that the study was conducted purely for research and data publication purposes and informed that written consent had been obtained from all included patients.

A history, clinical examination, and routine laboratory investigations, along with a chest radiograph, were performed to confirm enteric perforation by showing a gas shadow under the diaphragm. All exploratory laparotomies were performed under the supervision of an expert General Surgeon with a minimum of 5 years' experience. An expert radiologist with at least 5 years of experience reported all chest radiographs. Surgical site infections were evaluated on the 7th postoperative day based on redness (detected by the naked eye), swelling (detected by the naked eye), and discharge of pus (yellowish fluid coming out of the wound, confirmed by a culture test in the laboratory). An expert microbiologist with at least 5 years of experience reported all culture specimens. All the above information, including age, gender, duration of symptoms, diabetes mellitus, hypertension, and smoking status, was recorded in a predesigned Proforma. Exclusion criteria were strictly adhered to in order to control for confounders and bias in the study results. All the data were analyzed in SPSS 10.0. Mean and standard deviations were calculated for continuous variables, such as age and duration of symptoms. Frequencies and percentages were calculated for categorical variables, including gender, diabetes mellitus, hypertension, smoking status, and surgical site infection. Surgical site infection was stratified by age, gender, duration of symptoms, diabetes mellitus, hypertension, and smoking status to see the effect modifiers. Post-stratification chi-square test was applied, in which a P value of < 0.05 was considered significant. All the results are presented as tables and charts.

RESULTS

A total of 273 patients were observed. No death cases were reported throughout the entire study. The mean and standard deviation were calculated for age and duration of symptoms, which were 36.61 ± 10.16 years and 4.45 ± 3.56 days, respectively. All patients were distributed into four age groups. Most patients were in the 3rd decade of their life, i.e., the second age group. There were 76 (27.84%) patients in the 18-30 years age group, 115 (42.12%) patients in the 31-40 years age group, 46 (16.85%) patients in the 41-50 years age group, and 36 (13.19%) patients in the 51-60 years age group.

Table 1: Frequency of Surgical Site Infection

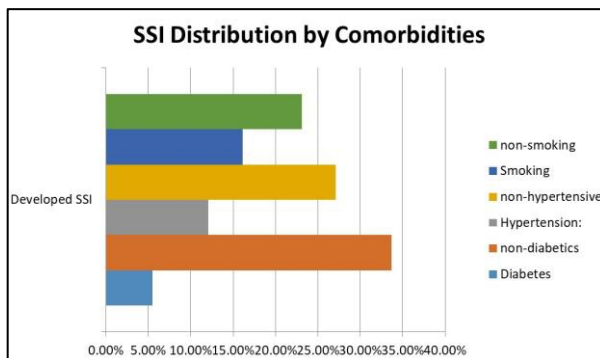
Surgical Site Infection	Frequency	%age
Yes	107	39.19%
No	166	60.81%

Table 2: Surgical Site Infection with Gender (n = 273)

Gender	Surgical Site Infection				P-Value
	Yes	%	No	%	
Male	67	24.54%	108	39.56%	0.681
Female	40	14.65%	58	21.25%	

Table 3: Surgical Site Infection with Age (n = 273)

Age Group	Surgical Site Infection				P-Value
	Yes	%	No	%	
18-30	27	9.89%	49	17.95%	0.705
31-40	45	16.48%	70	25.64%	
41-50	18	6.59%	28	10.26%	
51-60	17	6.23%	19	6.96%	

**Figure 1: It shows surgical site infection by comorbidities**

DISCUSSION

This study found a high rate of surgical site infection (SSI) of 39.19% among 273 patients undergoing primary closure. Neither gender (male vs female, $p = 0.681$) nor age group (18-30, 31-40, 41-50, 51-60 years; $p = 0.705$) showed a statistically significant association with SSI. These findings have several implications in light of the existing literature and suggest avenues for improving surgical care in cases of enteric perforation. The SSI rate of 39% in this study is relatively higher compared with many studies of gastrointestinal surgery and peritonitis, though somewhat similar to results in emergency settings with contaminated/dirty wounds. A retrospective study at Lahore General Hospital reported a wound infection rate of 38.7% in patients who had their skin closed after emergency intervention for gastrointestinal perforation and peritonitis, which is very close to our observed rate.¹² Similarly, in Abbottabad, a study of postoperative surgical site infections in a tertiary care hospital reported SSI in 33.68% of cases.¹³ On the other hand, studies in settings with less contamination or different closure techniques report lower SSI rates.

Such as Delayed Primary Closure (DPC) compared to Primary Closure (PC) in gastrointestinal perforation patients has been shown to reduce SSI significantly; in one randomized trial, PC had 42.9% infection vs 7.4% in DPC ($p=0.004$) in emergency perforation surgery.¹⁴ A meta-analysis of 12 randomized controlled trials found that DPC reduced SSI (odds ratio ~0.31) compared to PC in surgeries for GI perforation.¹⁵ In our study, age group and gender were not significantly associated with SSI ($p = 0.681$ for gender; $p = 0.705$ for age group). This suggests that, in primary closure for enteric perforation, the risk of infection may be more heavily influenced by other factors (delay in presentation, degree of contamination, comorbid conditions, surgical technique, perioperative care) than by age or gender alone. The literature is mixed regarding the relationship between age and gender. Some studies find that older age increases the risk of SSI; a multicentre risk-factor study in gastric surgery found age ≥ 65 years as an independent risk factor.¹⁶ In contrast, a study of emergency laparotomies found that while extremes of age were associated with higher morbidity, age was not always a significant predictor once other risk factors were controlled.¹⁷ Regarding gender, male sex has often been found associated with higher SSI risk (possibly due to higher rates of comorbidities, smoking, or differential immune responses).¹⁸ However, our finding that gender was not significant is also consistent with other studies where male/female differences were minor or confounded by other risk factors. Given the high rate of SSI, there is justification for considering delayed primary closure (DPC) instead of primary closure in thoroughly contaminated enteric perforation cases, especially when the wound cannot be made "clean" at the time of surgery. Optimization of perioperative management, including antibiotic prophylaxis, improving the preoperative condition (even in emergencies, such as resuscitation and source control), and minimizing delays, is crucial. Surveillance and standardization of wound care protocols postoperatively. Stratify patients at high risk (even if age/gender are not significant) for more intensive monitoring. Our study contributes valuable data in the specific population of patients with enteric perforation undergoing primary closure. It highlights that SSI risk is very high in this setting (39%) and that age/gender alone may not be reliable predictors, underscoring the importance of surgical and procedural factors.

LIMITATIONS

This study was conducted as a single-center case series with a relatively small sample size, which may limit the generalizability of the findings. Only clinical and

culture proven SSIs within 7 days postoperatively were assessed, potentially missing late-onset infections. Confounding factors such as nutritional status, intraoperative contamination grading, surgeon experience, and antibiotic protocols were not fully evaluated, which may have influenced the SSI rates. Future multicenter studies with larger sample sizes and longer follow-up are recommended to validate these results.

CONCLUSIONS

This study demonstrates a high frequency of surgical site infection (39.19%) in patients undergoing primary closure for enteric perforation. Neither age nor gender was significantly associated with SSI, suggesting that other clinical and procedural factors, such as degree of contamination, comorbidities, and perioperative management, may play a more substantial role. The findings highlight the challenges of wound management in contaminated abdominal surgeries and reinforce the need for improved strategies, such as consideration of delayed primary closure in selected cases, strict adherence to infection-control measures, and optimization of perioperative care protocols. Future multicenter studies with larger sample sizes, longer follow-up, and advanced statistical modeling are recommended to define independent predictors of SSI better and to establish evidence-based guidelines for wound closure techniques in enteric perforation.

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AUTHORS CONTRIBUTION

Muhammad Kalim - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Supervision; Final Approval

Atta Ullah Khan - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Final Approval

Muhammad Luqman - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Final Approval

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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