RESEARCH PAPER

Predictors of Surgical Site Infection Following Emergency Laparotomy: A Prospective Cohort Study.

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ABSTRACT
Background: Surgical site infection is a frequent complication following emergency laparotomy and contributes to increased morbidity and prolonged hospitalization. **Objective:** To identify predictors of surgical site infection following emergency laparotomy. **Methods:** This was a prospective cohort study conducted at Bolan Medical College Quetta from December 2024 to December 2025 including 265 patients undergoing emergency laparotomy. Patients were followed for 30 days postoperatively to assess the occurrence of SSI and associated risk factors. **Results**: The mean age was 49.1 ± 13.4 years, and SSI occurred in 30.9% of patients. Patients with SSI were older (54.2 ± 13.6 vs 46.8 ± 12.9 years; $p < 0.001$) and had higher prevalence of diabetes (43.9%), anemia (58.5%), and smoking (41.5%). Operative duration was longer (124.6 ± 32.5 vs 92.8 ± 28.4 minutes), and factors such as dirty wounds (43.9%), blood loss >500 mL (48.8%), and bowel resection (53.7%) were significantly associated ($p < 0.05$). SSI was associated with longer hospital stay (11.8 ± 4.6 vs 7.2 ± 2.9 days) and higher complication rates. Multivariate analysis identified prolonged surgery, dirty wounds, diabetes, and blood loss as independent predictors. **Conclusion:** Surgical site infection following emergency laparotomy is influenced by multiple patient and operative factors, and early identification of high-risk patients may help improve outcomes
Keywords: *Surgical site infection; Emergency laparotomy; Risk factors; Postoperative complications; Cohort study*.
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INTRODUCTION

One of the most prevalent postoperative complications is surgical site infections (SSIs) that with their contribution to morbidity increase, long-term hospitalization, and high healthcare expenses are regarded as the most common postoperative complications [1]. They occur especially after emergency surgeries, when little preoperative optimization, contamination, and physiological instability expose them to the risk of infection [2]. Emergency laparotomy which is usually done to treat life threatening conditions in the abdomen has significantly high chance of SSI than elective surgeries [3]. SSIs are linked to other negative clinical outcomes, such as wound dehiscence, sepsis, slow recovery, and mortality [4]. The SSI weight is particularly high in the low- and middle-income countries, where the lack of resources, the delay in presentation, and the problems with infection control contribute to the further worsening of the issue [5]. It is hence necessary to identify patients at high risk of developing SSI early enough in order to implement preventive measures and enhance surgical outcomes [6].

There are several things that have been attributed to the occurrence of SSIs after emergency laparotomy. Patient factors like old age, malnutrition, diabetes mellitus, anemia and immunosuppression have been found to predispose to infection [7]. Moreover, during the operation, such factors as the length of surgery, the level of contamination, blood loss, and method of operation are also critical in the assessment of risk of infection [8]. Poor wound care, long hospitalization, and invasive devices can also be some of the postoperative causes of SSI [9]. The host factors, microbial contamination and perioperative management finally decide on the chances of infection [10]. In spite of the development of the surgical practice and infection control strategies, SSIs continue to pose a challenge in emergency surgery units [11].

There are various studies that have tried to establish predictors of SSI to implement focused interventions but

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the results are inconclusive because of the differences in the study design, the population of the patients, and clinical practices [12]. Although other studies have shown the significance of comorbid conditions, some others have shown intraoperative and environmental factors to be critical determinants [13]. This inconsistency highlights the importance of context-specific information to learn more about risk factors in various healthcare environments [14]. Prospective data were also scarce in the local area to assess predictors of SSI after an emergency laparotomy, even though surgical infections are very common [15]. Determining both modifiable and non-modifiable risk factors can be useful to maximize the care provided in the perioperative setting and minimize postoperative complication rates.

Objective

To identify predictors of surgical site infection following emergency laparotomy.

Methodology

This was a prospective cohort study conducted at Bolan Medical College Quetta from December 2024 to December 2025, including 265 patients undergoing emergency laparotomy. Patients were enrolled consecutively and followed postoperatively to identify the incidence of surgical site infection and evaluate associated risk factors.

Inclusion Criteria

Patients aged ≥18 years undergoing emergency laparotomy for acute abdominal conditions

Patients willing to participate and provide informed consent

Patients with complete perioperative data and follow-up

Exclusion Criteria

Patients undergoing elective laparotomy

Patients with pre-existing wound infection at the time of surgery

Patients who died within 48 hours postoperatively before SSI assessment

Patients with incomplete clinical records or lost to follow-up

Data Collection

After ethical approval, demographic and clinical data were collected using a structured proforma, including age, gender, body mass index, comorbidities (diabetes mellitus, anemia), and preoperative clinical status. Intraoperative variables such as indication for surgery, duration of surgery, degree of contamination (clean-contaminated, contaminated, dirty), blood loss, and need for bowel resection were recorded. Postoperative variables including antibiotic use, wound care practices, and length of hospital stay were also documented. Patients were followed for 30 days postoperatively, and surgical site infection was diagnosed based on standard clinical criteria, including purulent discharge, redness, swelling, pain, or wound dehiscence.

Statistical Analysis

Data were entered and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Comparisons between patients with and without SSI were performed using independent t-test and chi-square test as appropriate. Multivariate logistic regression analysis was conducted to identify independent predictors of SSI. Adjusted odds ratios with 95% confidence intervals were reported. A p-value of ≤0.05 was considered statistically significant.

Results

Patients with SSI were older, with a mean age of 54.2 ± 13.6 years compared to 46.8 ± 12.9 years in non-SSI ($p < 0.001$), and a higher proportion >50 years (65.9% vs 46.4%). Gender distribution was similar. Mean BMI was higher in SSI (27.8 ± 4.6 vs 25.9 ± 3.8 kg/m²; $p = 0.002$). Diabetes (43.9% vs 23.0%; $p = 0.001$), anemia (58.5% vs 39.3%; $p = 0.005$), and smoking (41.5% vs 25.1%; $p = 0.010$) were more frequent in SSI patients.

Table 1. Demographic and Clinical Characteristics (N = 265)

Variable	Category	SSI (n=82)	No SSI (n=183)	Total (N=265)	p-value
Age (years)	Mean ± SD	54.2 ± 13.6	46.8 ± 12.9	49.1 ± 13.4	<0.001
Age Group	≤50 years	28 (34.1%)	98 (53.6%)	126 (47.5%)	0.004
	>50 years	54 (65.9%)	85 (46.4%)	139 (52.5%)	0.004
Gender	Male	52 (63.4%)	108 (59.0%)	160 (60.4%)	0.512
	Female	30 (36.6%)	75 (41.0%)	105 (39.6%)	0.512
BMI (kg/m²)	Mean ± SD	27.8 ± 4.6	25.9 ± 3.8	26.5 ± 4.2	0.002
BMI Category	<25	18 (22.0%)	50 (27.3%)	68 (25.7%)	0.412
	25–29.9	38 (46.3%)	72 (39.3%)	110 (41.5%)	0.298
	≥30	26 (31.7%)	61 (33.3%)	87 (32.8%)	0.801
Diabetes Mellitus	Present	36 (43.9%)	42 (23.0%)	78 (29.4%)	0.001
Anemia	Present	48 (58.5%)	72 (39.3%)	120 (45.3%)	0.005
Smoking	Present	34 (41.5%)	46 (25.1%)	80 (30.2%)	0.010

Operative factors differed significantly. Surgery duration was longer in SSI (124.6 ± 32.5 vs 92.8 ± 28.4 minutes; p <0.001), with more procedures >120 minutes (56.1% vs 20.8%). Dirty wounds were more common in SSI (43.9%

vs 26.8%; p = 0.008). Blood loss >500 mL was higher (48.8% vs 25.1%; p <0.001), and bowel resection was more frequent (53.7% vs 33.9%; p = 0.004).

Table 2. Intraoperative Factors (N = 265)

Variable	Category	SSI (n=82)	No SSI (n=183)	Total (N=265)	p-value
Duration of Surgery (minutes)	Mean ± SD	124.6 ± 32.5	92.8 ± 28.4	102.3 ± 33.1	<0.001
Duration Category	≤120 minutes	36 (43.9%)	145 (79.2%)	181 (68.3%)	<0.001
	>120 minutes	46 (56.1%)	38 (20.8%)	84 (31.7%)	<0.001
Degree of Contamination	Clean-contaminated	18 (22.0%)	72 (39.3%)	90 (34.0%)	0.006
	Contaminated	28 (34.1%)	62 (33.9%)	90 (34.0%)	0.971
	Dirty	36 (43.9%)	49 (26.8%)	85 (32.1%)	0.008
Blood Loss	≤500 mL	42 (51.2%)	137 (74.9%)	179 (67.5%)	<0.001
	>500 mL	40 (48.8%)	46 (25.1%)	86 (32.5%)	<0.001
Bowel Resection	Yes	44 (53.7%)	62 (33.9%)	106 (40.0%)	0.004
	No	38 (46.3%)	121 (66.1%)	159 (60.0%)	0.004

SSI was associated with worse outcomes. Length of stay was longer (11.8 ± 4.6 vs 7.2 ± 2.9 days; p <0.001), ICU admission was higher (31.7% vs 13.1%; p = 0.001), and complications such as wound dehiscence (26.8% vs 3.3%) and sepsis (22.0% vs 5.5%) were significantly more frequent (p <0.001). Among SSI cases, superficial infection was most common (46.3%), followed by deep (31.7%) and organ/space infection (22.0%).

Table 3. Postoperative Outcomes (N = 265)

Variable	Category	SSI (n=82)	No SSI (n=183)	Total (N=265)	p-value
Length of Stay (days)	Mean ± SD	11.8 ± 4.6	7.2 ± 2.9	8.6 ± 3.9	<0.001
ICU Admission	Yes	26 (31.7%)	24 (13.1%)	50 (18.9%)	0.001
	No	56 (68.3%)	159 (86.9%)	215 (81.1%)	0.001
Wound Dehiscence	Present	22 (26.8%)	6 (3.3%)	28 (10.6%)	<0.001
	Absent	60 (73.2%)	177 (96.7%)	237 (89.4%)	<0.001
Sepsis	Present	18 (22.0%)	10 (5.5%)	28 (10.6%)	<0.001
	Absent	64 (78.0%)	173 (94.5%)	237 (89.4%)	<0.001
SSI Type	Superficial	38 (46.3%)	0 (0.0%)	38 (14.3%)	<0.001
	Deep	26 (31.7%)	0 (0.0%)	26 (9.8%)	<0.001
	Organ/space	18 (22.0%)	0 (0.0%)	18 (6.8%)	<0.001

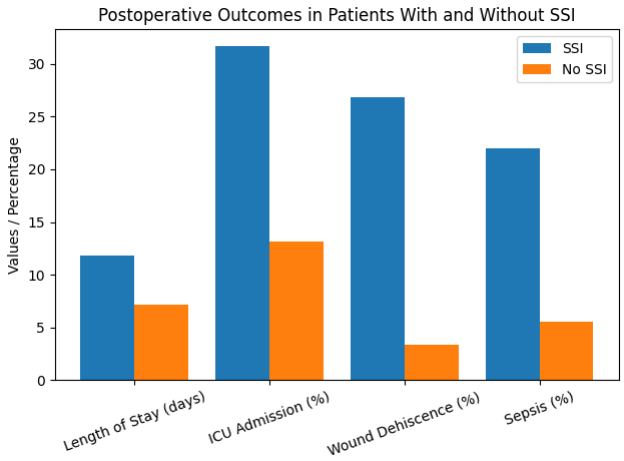

Figure 1. Comparison of Postoperative Outcomes Between Patients With and Without Surgical Site Infection (SSI)

Multivariate analysis identified significant independent predictors of SSI, including duration >120 minutes (OR 3.42; p <0.001), dirty wounds (OR 2.76; p = 0.001), diabetes (OR 2.63; p = 0.001), blood loss >500 mL (OR 2.19; p = 0.009), BMI ≥30 (OR 2.21; p = 0.007), age >50 years (OR 1.98; p = 0.018), anemia (OR 1.87; p = 0.031), and bowel resection (OR 1.84; p = 0.036).

Table 4. Multivariate Analysis of Predictors of SSI

Variable	Adjusted OR	95% CI	p-value
Age >50 years	1.98	1.12 – 3.48	0.018
BMI ≥30 kg/m²	2.21	1.24 – 3.94	0.007
Diabetes Mellitus	2.63	1.45 – 4.78	0.001
Anemia	1.87	1.06 – 3.29	0.031
Duration >120 min	3.42	1.89 – 6.19	<0.001
Dirty Wound	2.76	1.51 – 5.03	0.001
Blood Loss >500 mL	2.19	1.22 – 3.93	0.009
Bowel Resection	1.84	1.04 – 3.26	0.036

DISCUSSION

The present study revealed that the incidence of surgical site infection after emergency laparotomy is high (30.9) indicating the high risk of emergency abdominal surgery. Patients with SSI were older (54.2 ± 13.6 years) and had more comorbidities, including diabetes (43.9%), anemia (58.5%), and smoking (41.5%), which means that the patient-related factors are crucial in infection risk. The same results have been observed in other studies conducted in the past, with old age and comorbidity always being linked to an increased vulnerability to postoperative infections [16]. SIS development was strongly related to operative factors. In the SSI patients, longer (124.6 ± 32.5 minutes) and increased percentage of longer than 120 minutes surgical duration (56.1) were experienced. Also, dirty wounds (43.9%), excess blood loss (>500 mL in 48.8%), and bowel resection (53.7%) were much more frequent. These results indicate that the level of contamination and the complexity of the surgery are the main factors that can contribute to the risk of infection. Other studies have also shown that the duration of operation, intraoperative contamination, and extensive surgery are also major causes of SSI [17]. Patients with SSI had significantly poorer postoperative outcomes. The length of hospital stay was extended (11.8 plus 4.6 vs 7.2 plus 2.9 days) and increased incidences of ICU (31.7), wound dehiscence (26.8), and sepsis (22.0) were found. These results indicate the clinical and economic cost of SSI. Other studies have also documented elevated morbidity, extended hospitalization and increased complication rates in postoperative infections patients [18].

The frequencies of SSI types revealed that the most frequent was superficial infections (46.3%), then deep (31.7%), and then organ/space infections (22.0), which revealed the range of disease severity. Other studies have reported similar distributions, with the majority of cases having superficial SSIs but depthier infections having worse outcomes [19]. The multivariate analysis revealed a number of independent predictors of SSI such as long operation (more than 120 minutes), dirty wounds, diabetes mellitus, large blood loss, obesity, old age, anemia, and bowel section. Among them, the strongest predictors were duration of surgery (OR 3.42) and wound contamination (OR 2.76) which highlights the role of intraoperative factors. These variables are also highlighted as the key determinants of SSI by previous research, which substantiates the validity of the present findings [20]. In

general, the paper highlights the fact that SSI after emergency laparotomy is multimodal, with patient-related, intraoperative, and postoperative variables. These findings are consistent with prior studies, which reinforces the notion of using specific interventions, such as optimization of comorbidities, reduction of operative time and blood loss, and the implementation of stringent infection control strategies to decrease SSI rates and improve surgical outcomes.

CONCLUSION

It is concluded that surgical site infection is a common and significant complication following emergency laparotomy, with an incidence of 30.9%. Advanced age, higher BMI, diabetes mellitus, anemia, prolonged duration of surgery, dirty wound classification, increased blood loss, and bowel resection were identified as significant predictors of SSI. Patients with SSI experienced worse postoperative outcomes, including longer hospital stay and higher rates of complications such as sepsis and wound dehiscence. These findings highlight the importance of early risk stratification and targeted perioperative interventions to reduce SSI and improve surgical outcomes

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