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ORIGINAL ARTICLE

PREDICTORS AND EARLY OUTCOMES OF SURGICAL SITE INFECTIONS AFTER STOMA REVERSAL: A SECONDARY CARE HOSPITAL EXPERIENCE

Imtiaz Ahmed Khattak[1], Sohail Aziz Paracha[2], Muhammad Israr Khan[3], Syed Iftikhar Alam[3], Waleed Mabood[4], Muhammad Kabir Afridi[2]

Departments of [1]Surgery, [2]Anatomy, Khyber Medical University Institute of Medical Sciences (KMU-IMS), KDA, Kohat, [3]Department of Surgery, KMU-IMS DHQ Teaching Hospital KDA, Kohat, [4]Department of Surgery, Mercy Teaching Hospital, Peshawar Medical college, Peshawar, Pakistan

ABSTRACT

Background: Surgical site infections (SSIs) remain a key concern after stoma reversal, increasing morbidity, hospital stays and healthcare costs. Various predictors can influence SSI risk and early surgical outcomes. Identifying these predictors in a secondary care setting is critical for optimizing patient management and improving infection prevention strategies. The aim of this study was to identify key predictors and evaluate early outcomes of SSI following stoma reversal in a secondary care hospital.

Materials & Methods: This descriptive observational study was conducted from January 2021 to April 2022 at the Department of Surgery, KMU-IMS, DHQ Teaching Hospital, Kohat. It included 124 stoma reversal patients selected through non-probability convenient sampling. Elective surgery was performed using the purse-string closure technique. Patients were monitored postoperatively and assessed for complications on 7th, 14th & 30th day postoperatively. Data was collected using a structured proforma and analyzed with SPSS V21.

Results: Among 124 patients (mean age 34.54 ± 8.19 years, male-to-female ratio 1.48:1, mean BMI 29.18 ± 5.20 kg/m^2), the mean stoma duration was 3.42 ± 1.47 months and hospital stay averaged 3.79 ± 1.42 days. SSIs occurred in 19.35% (n=24), with superficial (47.05%) and deep incisional (33.33%) infections most common. SSIs were significantly associated with age (p=0.005), diabetes (p=0.01) and smoking (p=0.03). SSI patients had longer hospital stays (10.3 vs. 4.5 days, p<0.00001) and higher complication rates, including paralytic ileus (p=0.0001) and wound dehiscence (p=0.010).

Conclusion: SSIs after stoma reversal were linked to age, diabetes and smoking, leading to increased complications and hospital stays. Targeted preoperative optimization and strict wound care protocols may improve outcomes.

KEY WORDS: Colostomy; Ileostomy; Postoperative Complications; Risk Factors; Surgical Site Infection.

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INTRODUCTION

Surgical site infections (SSIs) are a significant concern in postoperative care, particularly following stoma reversal procedures. These infections increase patient morbidity and impose a substantial economic burden on healthcare systems.[1] Despite advancements in surgical techniques and infection control, SSIs remain prevalent, affecting about 11% of surgical patients in low and middle income countries.[2] The impact is compounded by prolonged hospital stays, increased antibiotic use and higher treatment costs.[1] Secondary care hospitals, which often function with limited resources, face unique challenges in managing such infections effectively. These limitations make it crucial to study SSIs in these settings, where tailored interventions may be necessary.

Current knowledge on SSIs following stoma reversal highlights several risk factors including patient-related variables such as age, comorbidities and nutritional

Corresponding Author:

Prof. Dr. Sohail Aziz Paracha
Department of Anatomy
Khyber Medical University Institute of Medical Sciences (KMU-IMS)
KDA, Kohat, Pakistan
E-mail: drsohailparacha@gmail.com

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status, and procedural factors like stoma type and surgical technique used. [3] A study published in 2023 reported that the incidence of surgical site infections (SSIs) may be as high as 41%, with notable variation influenced by the type of surgical procedure and patient demographic factors.[4] Although some data exist, most derive from tertiary centers with advanced infrastructure. As such, they may not reflect the conditions and constraints in secondary care. There remains a pressing need for comprehensive, context-specific data to guide prevention and management strategies in lower resource environments, where patient outcomes may be more vulnerable to these limitations.

Although stoma closure is often categorized as a "minor" procedure, it carries notable risks of morbidity and mortality. [1] Common postoperative complications include bowel obstruction, anastomotic leakage, intra-abdominal infections, and wound infections. [3] Among these, wound infection and sepsis are the most frequently observed, often progressing to septicemia, incisional hernias, prolonged hospitalization, and increased healthcare expenditure. [2] Despite notable improvements in perioperative care, overall rates of postoperative complications remain largely unchanged in many settings. Wound infections, in particular, continue to be the most common, accounting for nearly 28% of nosocomial infections globally. [(1)] These challenges emphasize the importance of adopting meticulous surgical technique and following evidence based practices to mitigate risks. [5, 6]

The primary objective of this descriptive observational study was to identify key predictors and assess early outcomes of SSIs following stoma reversal in a secondary care hospital. By analyzing patient demographics, clinical profiles and postoperative results, the study aimed to uncover modifiable risk factors and evaluate the adequacy of current preventive strategies.[3] The findings will help inform clinical decision-making and support the development of effective, evidence based protocols tailored to secondary care needs. In summary, this study addresses a critical evidence gap and aims to improve patient outcomes through focused, context specific insights into SSIs after stoma reversal.

MATERIALS AND METHODS

This descriptive observational study was carried out from January 1, 2021, to April 1, 2022, at Department of Surgery, KMU-IMS, DHQ Teaching Hospital, Kohat. Prior to initiation, ethical clearance was obtained from the hospital's ethical review board (Letter #8358 dated 31-12-2020). Written informed consent was obtained from all participants after explaining the objectives, procedure and potential risks of the study. Patients undergoing surgery for stoma reversal were enrolled using a non-probability convenient sampling technique.

Patients of either gender aged 20 years and above classified as American Society of Anesthesiologists (ASA) Class I, II, or III and scheduled for elective colostomy or ileostomy reversal were included. Exclusion criteria comprised patients with postoperative anastomotic leaks, existing stoma site infections, obesity with a BMI over 35 kg/m^2, incomplete follow-up, prior parastomal hernia repaired with mesh, those on systemic immunosuppressive therapy, undergoing revisional stomal surgery, or having end stomas. The sample size was estimated using the WHO Sample Size Calculator version 1.1, with reference to a 6.8% reported frequency of surgical site infections (SSIs) after stoma reversal using the purse-string technique. [7] Using a 5% margin of error and a 95% confidence interval, the required sample size was calculated as 98. To compensate for potential dropouts or missing data, the final sample size was increased to 124.

Patients fulfilling the inclusion criteria underwent detailed preoperative evaluation, including a complete set of relevant investigations and a distal loopogram to confirm distal bowel patency. Patients were scheduled for surgery the following day as elective cases. Mechanical bowel preparation was performed a day before the procedure and a consultant anesthesiologist conducted a comprehensive assessment to ensure fitness for general anesthesia. A single dose of prophylactic antibiotics (ceftriaxone 1g plus metronidazole 500 mg) was administered intravenously prior to the induction of anesthesia.

Stoma reversal was performed by a consultant surgeon with over five years of post-fellowship experience, using the purse-string closure technique under general anesthesia. An elliptical incision was made around the stoma and extended down to the peritoneal cavity. After full mobilization of the bowel loop, gut continuity was restored with extra-mucosal single interrupted polyglycolic acid (Vicryl) 3/0 sutures. The rectus sheath was closed with continuous polypropylene (Prolene) 1 suture, and the skin was approximated using interrupted polypropylene 2/0 sutures. Postoperatively, patients remained fasting for 48 hours and were managed with intravenous antibiotics, analgesics and fluids. Discharge was considered once the patient resumed oral intake, was clinically stable and cleared by the attending surgeon.

Patients were reviewed in the surgical outpatient department on the 7th, 14th, and 30th postoperative days to evaluate for complications. Data were recorded using a structured proforma capturing demographics, clinical presentation, comorbidities, SSI status, complications and length of hospital stay. Data were entered and analyzed using SPSS version 21. Mean ± SD or median (IQR) was used for continuous variables and frequencies with percentages for categorical ones. Stratification based on SSI presence was done. Chi-square or Fisher's exact test assessed categorical differences, and independent t-test for continuous variables. A p-value ≤ 0.05 was considered statistically significant. Results were presented in tables and graphs.

RESULTS

The study included 124 patients scheduled for stoma closure, aged 20–56 years (mean 34.54 ± 8.19 years), with a male-to-female ratio of 1.48:1. The mean BMI was 29.18 ± 5.20 kg/m², mean duration of stoma was 3.42 ± 1.47 months, and mean hospital stay was 3.79 ± 1.42 days. Surgical site infection (SSI) occurred in 19.35% (n = 24) of patients. Surgical site infection (SSI) was observed in 19.35% (n=24) of patients. Distribution of SSI types across age and sex groups is summarized in Table 1.

Patients with SSI were older (38.90±7.28 vs. 33.49 ± 8.08, p=0.005). SSI was also significantly associated with duration of ostomy (p=0.01), initial diagnosis (p=0.04), diabetes mellitus (p=0.01), smoking (p=0.03) and hypertension (p=0.01). Other factors, including gender, residence, BMI, ASA classification, steroid use, weight loss, type of ostomy and CAD showed no significant differences (p>0.05) (Table 2).

Multivariate analysis (Table 3) identified no statistically significant independent predictors of SSI.

Postoperative outcomes showed higher rates of paralytic ileus, seroma/hematoma, wound dehiscence, sepsis/bacteremia, additional minor procedures, and longer hospital stays in the SSI group compared with the non-SSI group (Table 4).

Table 1: Age and sex distribution by type of surgical site Infections in stoma reversal patients.

Age group	Total (n=124)	Females (n=50)	Males (n=74)	Type of SSI (n=24)		
	Frequency (%)	Frequency (%)	Frequency (%)	Superficial (n=17)	Deep incisional (n=6)	Organ/space (n=1)
20-30 years	43(34.67%)	18(36.00%)	25(33.78%)	8(47.05%)	2(33.33%)	0 (0%)
31-40 years	51(41.12 %)	20(40.00%)	31(41.89%)	7(41.17%)	2(33.33%))	0 (0%)
41-50 years	26(20.96 %)	10(20.00%)	16(21.62%)	1(5.88%)	1(16.66%)	0 (0%)
>50 years	04(3.22 %)	02(4.00%)	02(2.70%)	1(5.88%)	1(16.66%))	01(100%)

Table 3: Multivariate binary logistic regression analysis of predictors for SSI after stoma reversal.

Predictor	AOR	p value	95.0% Wald C.I limits for AOR	
			Lower	Upper
Duration of ostomy > 3 months	1.74	0.268	0.651	4.684
BMI > 25 kg/m²	1.16	0.800	0.360	3.764
DM	1.12	0.829	0.402	3.117
ASA III	1.66	0.330	0.597	4.637
Typhoid fever as initial diagnosis	1.07	0.901	0.365	3.142
Ileostomy	0.84	0.816	0.204	3.499

AOR: Adjusted Odds Ratio, CI: Confidence Interval, BMI: Body Mass Index DM: Diabetes Mellitus, ASA: American Society of Anesthesiologists

Table 4: Short-term postoperative outcomes comparing patients with and without surgical site infection (SSI) after stoma reversal.

Outcome	SSI (n=24)	No SSI (n=100)	Overall (n=124)	p value
Paralytic ileus	8 (33.33%)	7 (7.00%)	12 (12.09%)	0.0001
Seroma/Hematoma	12 (50.00%)	5 (5.00%)	17 (13.70%)	0.00001
Pneumonia	3 (%12.50)	3 (3.00%)	6 (4.83%)	0.09
Wound dehiscence	5 (20.83%)	5 (5.00%)	10 (8.06%)	0.010
Anastomotic leak	3 (12.50%)	7 (7.00%)	10 (8.06%)	0.299
Sepsis/Bacteremia	6 (25.00%)	5 (5.00%)	11 (8.87%)	0.002
Additional minor procedure(s)	20 (83.33%)	4 (4.00%)	24 (19.35%)	0.00001
Redo operation	9 (37.05%)	16 (16.00%)	25 (20.16%)	0.018
Re-admission	9 (37.05%)	16 (16.00%)	25 (20.16%)	0.018
ICU admission	8 (33.33%)	17 (17.00%)	23 (18.54%)	0.07
Hospital stay days (Mean+ SD)	5.20 ± 1.51	3.45±1.70	3.79 ± 1.42	0.001

Table 2: Comparison of patient characteristics between groups with and without surgical site infections (SSIs) following stoma reversal.

Parameter	With SSI (n=24)	Without SSI (n=100)	p value
Gender Male 74 Female 50	 16 (66.66) 8 (33.33)	 60 (60.00) 40 (40.00)	0.54
Residence Urban Rural	 16 (66.66) 8 (33.33)	 56 (56.00) 44 (44.00)	0.49
Socioeconomic status Upper class Middle class Lower class	 1(4.16) 8 (33.33) 15 (62.50)	 6 (6.00) 34 (34.00) 60 (60.00)	0.90
Age years (Mean+SD)	38.90±7.28	33.49 ± 8.08	0.005
BMI (Mean+SD) Normal weight (20–24.9 kg/m^2) Overweight (25-29.9 kg/m^2) Obese > (30 kg/m^2)	30.80± 4.55 6 (25.00) 8 (33.33) 10 (41.66)	28.80 ± 5.29 29 (29.00) 38 (38.00) 33 (33.00)	0.72
ASA I II III	 4 (16.66) 4 (16.66) 16 (66.66)	 20 (20.00) 60 (60.00) 20 (20.00)	0.27
Duration of stoma (Mean+SD) 1-3 months 4-6 months	3.89±1.20 7 (29.16) 17 (70.83)	3.30±1.51 58 (58.00) 42 (42.00)	0.01
Smoking	9 (20.83)	18 (15.00)	0.03
Diabetes mellitus	12 (20.83)	22 (28.00)	0.01
Hypertension	11 (25.00)	21 (21.00)	0.01
Chronic obstructive pulmonary disease	1 (4.16)	2 (2.00)	1.00
Coronary artery disease	1 (4.16)	2 (2.00)	1.00
Steroid use	2 (8.33)	11 (11.00)	0.62
Weight loss	1 (4.16)	3 (3.00)	1.00
Type of Ostomy Colostomy Ileostomy	 4 (16.66) 20 (83.33)	 16 (16.00) 84 (84.00)	0.93
Initial diagnosis Carcinoma Typhoid fever Chronic inflammation Others	 2 (8.33) 12 (50.00) 6 (25.00) 4 (16.66)	 28 (28.00) 28 (28.00) 28 (28.00) 16 (16.00)	0.04

DISCUSSION

This study highlights the predictors and outcomes of surgical site infections (SSIs) following stoma reversal in a secondary care setting. The SSI rate was 19.35%, predominantly superficial or deep incisional. Significant associations were found with older age, prolonged stoma duration, smoking, and comorbidities such as diabetes mellitus and hypertension. SSIs were linked to longer hospital stays and higher complication rates, underscoring the need for early identification of high-risk patients and targeted perioperative measures.

Older age showed a strong association with SSI, reflecting the greater vulnerability of elderly patients due to impaired immunity, delayed healing, and reduced tissue perfusion. A higher prevalence of SSI was noted in patients aged over 50, in line with findings by Bischoff et al.[8] and large cohort data indicating a yearly incremental risk of SSI with age. [9] These results support age-sensitive perioperative protocols, including enhanced surveillance and tailored preventive strategies for geriatric patients undergoing stoma reversal.

Smoking and prolonged stoma duration also emerged as significant SSI predictors. Smoking impairs oxygen delivery, neutrophil function, and collagen deposition [10], while abstinence at least four weeks preoperatively can normalize SSI risk. [11] Extended stoma retention may cause chronic inflammation and fibrosis, impairing wound healing. [12] Timely closure is therefore recommended, as supported by Hsu et al., who reported increased complications with delayed reversal. [13]

Although diabetes mellitus and hypertension did not remain independent predictors in multivariate analysis, their pathophysiological links to impaired perfusion and immune response are well documented. [14] Prior studies show diabetes increases SSI risk by 53% [15] and hypertension elevates risk, especially when poorly controlled. [1] Optimizing glycemic and blood pressure control remains essential in perioperative care for high-risk procedures like stoma reversal.

Factors such as typhoid fever, elevated BMI, and stoma type were not statistically significant here but are clinically relevant. Typhoid fever, common in South Asia, predisposes to delayed healing and infection. [16] Our cohort reflects this regional pattern, similar to Karachi data showing typhoid perforation as the main stoma indication. [17] Obesity (>30 kg/m^2) increases SSI risk through reduced vascularity and closure difficulty [2], while colostomy reversal has been reported to have a five-fold higher SSI risk than ileostomy reversal [2]. These findings support individualized risk assessment and region-specific protocols.

Our SSI rate of 19.35% falls within the range reported in previous study (18.3%–36%). [18] Common complications, including wound infections, anastomotic leak, and paralytic ileus, mirror previous reports. SSIs are known to prolong hospital stays and increase costs, as shown in large-scale analyses. [19, 20] These results reaffirm the need for vigilant perioperative care to detect and manage SSIs early.

In our study, SSIs were associated with longer hospitalization and increased minor procedures, consistent with literature. [7] Common interventions included wound debridement, vacuum-assisted closure, and frequent dressings, which increase healthcare burden and affect patient satisfaction. Comprehensive SSI prevention protocols covering patient education, intraoperative sterility, and wound surveillance are vital to improve recovery and reduce resource strain.

This study has limitations, including its single-center design, limited sample size, and reliance on clinical diagnosis for SSI, which may affect generalizability and introduce observer bias. Nevertheless, it offers locally relevant data. Future multicenter research with standardized SSI definitions and larger populations should explore additional risk factors such as nutritional status, anemia, adherence to safety protocols, and preoperative education to strengthen preventive strategies in stoma reversal.

CONCLUSION

SSI after stoma reversal was significantly associated with age, diabetes, smoking, and wound classification, leading to longer hospital stays and increased complications. Preoperative optimization, strict glycemic control, and enhanced wound care protocols may reduce SSI risk. Further studies should explore preventive strategies for high-risk patients.

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CONFLICT OF INTEREST
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	IAK, SAP
Acquisition, Analysis or Interpretation of Data:	IAK, SAP, MIK, SIA, WM, MKA
Manuscript Writing & Approval:	IAK, SAP, MIK, SIA, WM, MKA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.