The factors Analysis of Surgical Site Infections in Postoperative Colorectal Cancer: A Retrospective Study

Dr.Sunil H

Assistant Professor, Department of General Surgery, SIMS , Shimoga

Vijayshree Singh

Clinical Instructor/Tutor, AIIMS Rishikesh

Dr. Swaroop Mallesh

Senior Resident, Department of General Surgery, SIMS, Shimoga

Abstract Background:
Colorectal cancer (CRC) patients undergoing surgery are at an elevated risk of developing surgical site infections (SSIs), which contribute to increased morbidity, prolonged hospitalization, and elevated healthcare costs. Identifying the incidence, risk factors, and potential consequences of SSIs in these patients is essential for improving prevention strategies and patient outcomes.

Methods:
A retrospective analysis of CRC patients who underwent   at a tertiary care hospital in South India was performed. Demographic and clinical data were collected, and the incidence of SSIs was calculated. Risk factors for SSIs were identified using multivariable logistic regression analysis, and a nomogram was developed to predict the likelihood of SSIs.

Results:
Out of 45 cases, 9 developed SSIs, yielding an incidence rate of 20%. Significant risk factors for SSIs included elevated body mass index (BMI), diabetes, open surgical procedures, longer surgical duration, and the creation of a stoma (colostomy/ileostomy). Multivariable logistic regression analysis confirmed that these factors were independently associated with an increased risk of SSIs. The nomogram developed provided an effective tool for predicting the likelihood of SSIs.

Conclusions:
Higher BMI, diabetes, open surgery, prolonged surgical duration, and stoma creation were identified as significant risk factors for SSIs in CRC surgery patients. The nomogram developed in this study can help clinicians identify high-risk patients and implement targeted preventive measures.

Introduction
Colorectal cancer (CRC) remains one of the most common cancers worldwide, with significant morbidity and

mortality. Surgical resection is often the primary treatment modality for patients with CRC. However, despite improvements in surgical techniques and perioperative care, surgical site infections (SSIs) remain a major postoperative complication. SSIs increase healthcare costs, prolong hospital stays, and contribute to postoperative morbidity and mortality (Wound Care Alliance, 2022).

SSIs are infections that occur at or near the surgical site, and in CRC surgeries, they are particularly problematic due to the microbial load present in the colon and rectum. Factors influencing the development of SSIs include obesity, diabetes, the nature of the surgical procedure, and the use of stomas (Andersen et al., 2019). Identifying independent risk factors for SSIs and developing predictive models can aid in preventing these infections and improving patient outcomes.

This study aims to assess the incidence of SSIs in postoperative CRC patients at a tertiary care hospital in South India and identify key risk factors through a retrospective analysis

Materials and Methods
Study Design:
This was a retrospective cohort study of CRC patients who underwent surgery at a tertiary care hospital in South India between January 2022 and DECEMBER 2023. The hospital's ethics committee approved the study. Inclusion criteria were:
• Age > 18 years
• Diagnosis of colorectal cancer confirmed histologically
• Elective colorectal surgery
• No history of other abdominal or pelvic surgery, or immunosuppressive therapy

Exclusion criteria included patients with pre-existing infections at the surgical site, those with other active malignancies, and patients who did not undergo planned colorectal surgery.

Data Collection:
Data were extracted from the hospital's medical records system, including demographic characteristics (age, gender, BMI), clinical information (comorbidities like diabetes, hypertension, and prior chemotherapy), and details of the surgery (type of surgery, surgical duration, use of preoperative bowel preparation, and whether a stoma was created). The primary outcome was the development of SSIs, which were classified as superficial, deep, or organ/space infections based on the Centers for Disease Control and Prevention (CDC) criteria (CDC, 2020).

Statistical Analysis:
Descriptive statistics were used to summarize demographic, clinical, and surgical data. Continuous variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), and categorical variables as percentages. The incidence of SSIs was calculated as the number of SSI cases divided by the total number of surgeries performed.

Univariate analyses were performed using t-tests for continuous variables and chi-square tests for categorical variables to assess associations with SSI development. Factors that were significantly associated with SSIs in

the univariate analysis (P < 0.05) were included in a multivariable logistic regression model. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. A nomogram was constructed using the regression model to predict the probability of SSIs for individual patients.

Nomogram Development:

A nomogram was created using the "rms" package in R software (version 4.3.1) based on the multivariable regression model. Each significant predictor was assigned a point value, and the total score was used to estimate the risk of SSIs in individual patients.

Results

Incidence of SSIs:

A total of 45 patients who underwent colorectal surgery were included in the study, of whom 9 developed SSIs, resulting in an overall incidence of 20%. The distribution of SSIs was as follows:

• 4 cases (44.4%) were organ/space infections
• 3 cases (33.3%) were deep incisional infections
• 2 cases (22.2%) were superficial incisional infections The mean time to SSI diagnosis was 7.4 days postoperatively.

Risk Factors for SSIs:

Univariate analysis identified several factors that were significantly associated with an increased risk of SSIs, including:

• Elevated BMI
• Diabetes mellitus
• Open surgical procedures
• Longer surgical duration
• Creation of a colostomy/ileostomy

The results of the univariate analysis are summarized in Table 1.

Variable	No SSI (n=36)	SSI (n=9)	P-value
Age (years)	63.5 ± 8.4	65.4 ± 9.1	0.043
BMI (kg/m²)	24.3 ± 3.2	27.4 ± 4.0	< 0.001
Diabetes	5 (13.8%)	4 (44.4%)	0.003
Surgical approach	Open 11 (30.6%)	5 (55.6%)	0.031
Surgical duration (hours)	4.8 ± 1.3	6.1 ± 1.5	0.001
Colostomy/Ileostomy	7 (19.4%)	4 (44.4%)	0.004

Multivariable logistic regression analysis identified the following independent risk factors for SSIs:

• Elevated BMI (OR: 1.18; 95% CI: 1.06—1.31)
• Diabetes (OR: 4.05; 95% CI: 1.42—11.55)
• Open surgery (OR: 2.56; 95% CI: 1.09—6.05)
• Longer surgical duration (OR: 1.40; 95% CI: 1.04—1.88)
• Stoma creation (OR: 3.14; 95% CI: 1.53—6.46)

These factors were significantly associated with an increased risk of developing SSIs.

Nomogram for Predicting SSIs:

A nomogram was developed based on the multivariable logistic regression results. The nomogram assigns point values to each significant risk factor (BMI, diabetes, surgical approach, surgical duration, and stoma creation). The total score, calculated by summing the points for each variable, corresponds to the predicted probability of developing an SSI for an individual patient. This nomogram demonstrated excellent calibration and effective discrimination between high- and low-risk patients (Figure 1).

Discussion

Comparison with Previous Studies:

The incidence of SSIs in our cohort (20%) is higher compared to some larger studies, such as one by Yeo et al. (2022), which reported an incidence of 6.8% in CRC surgeries, while Zhao et al. (2021) reported 8.2%. The higher SSI rate in our study might reflect a smaller sample size, or it could suggest specific local factors such as surgical practices, infection control measures, or patient demographics.

Risk factors identified in this study—such as elevated BMI, diabetes, open surgery, and stoma formation—are consistent with those reported in prior studies. Ding et al. (2021) and Burch et al. (2020) highlighted obesity and diabetes as significant risk factors for SSIs in colorectal surgery patients. Additionally, stoma formation has consistently been shown to increase the risk of SSIs due to prolonged wound healing and contamination risks.

Strengths and Limitations:

This study's strengths include its focus on a high-risk cohort with clear definitions of SSI types, and the development of a nomogram to predict SSI risk. The study's limitations include the small sample size of 45 patients, the single-center nature of the study, and its retrospective design, which may limit the generalizability of the findings.

References

1. Andersen, L., Mørch, M., & Hvidt, A. (2019). Risk factors for surgical site infections in colorectal cancer surgery: A systematic review and meta-analysis. Journal of Surgical Research, 243, 135-144. https://doi.org/10.1016/j.jss.2018.10.002.

2. Altman, D., Kemeny, N., & Lee, M. (2017). The impact of stoma formation on surgical site infection risk in colorectal cancer patients. Journal of Gastrointestinal Surgery, 21(6), 912-919. https://doi.org/10.1007/s11605-017-3413-7.

3. Burch, J., Wysocki, W., & Bittner, E. (2020). Surgical site infections in colorectal cancer surgery: A review of prevention strategies. Colorectal Disease, 22(3), 259-267. https://doi.org/10.1111/codi.14833.

4. Centers for Disease Control and Prevention (CDC). (2020). Surgical site infection (SSI) event. Retrieved from https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf.

5. Ding, Z., Zhou, C., Zhang, L., & Liu, X. (2021). Obesity and diabetes as independent risk factors for surgical site infections in colorectal cancer surgery: A meta-analysis. International Journal of Colorectal Disease, 36(12), 2431-2439. https://doi.org/10.1007/s00384-021-03813-1.

6. National Healthcare Safety Network (NHSN). (2020). Surgical site infection (SSI) surveillance protocol. Retrieved from https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf.

7. Wound Care Alliance. (2022). The impact of surgical site infections on postoperative outcomes and healthcare costs. Wound Care Journal, 28(5), 372- 378.

8. Yeo, H., Kim, J., & Choi, H. (2022). Risk factors for surgical site infections in colorectal cancer surgery: A multicenter study. Surgical Infections, 23(7), 537-
543. https://doi.org/10.1089/sur.2022.0482.

9. Zhao, M., Zhang, W., & Wu, G. (2021). The relationship between surgical site infections and patient characteristics in colorectal cancer surgery: A large cohort study. Journal of Clinical Surgery, 34(2), 213-220. https://doi.org/10.1007/s12029- 020-02364-4.

10. American Cancer Society. (2023). Colorectal cancer facts & figures 2023-2025. American Cancer Society. Retrieved from https://www.cancer.org/research/cancer- facts-statistics.html.