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Surgical Site Infection Rates and Risk Factors in Elective Laparoscopic Cholecystectomies: A Prospective Observational Study

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A B S T R A C T

***Background*:** Surgical site infections (SSIs) are a common complication following elective laparoscopic cholecystectomy. Identifying the incidence and risk factors associated with SSIs is crucial for improving surgical outcomes. ***Objective*:** To determine the incidence of SSIs and identify the risk factors associated with infections in patients undergoing elective laparoscopic cholecystectomy. ***Methods*:** A prospective observational study was conducted with 50 patients who underwent elective laparoscopic cholecystectomy. Demographic data, surgical details, and postoperative outcomes were recorded. SSIs were classified into superficial, deep incisional, and organ/space infections. Risk factors such as diabetes, BMI, smoking, and operative time were analyzed using statistical methods. ***Results*:** The overall incidence of SSIs was 10%, with 5 patients developing infections: 3 superficial (6%), 1 deep incisional (2%), and 1 organ/space infection (2%). Diabetes was significantly associated with SSIs (30%, $p = 0.02$), as was obesity (BMI >30) with 25% of obese patients affected ($p = 0.03$). Prolonged operative time (>120 minutes) was another significant risk factor (33.3%, $p = 0.01$). Smoking showed a trend toward increased infection risk but was not statistically significant (25%, $p = 0.08$). Common pathogens included *Escherichia coli*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*. Two of the infections involved antibiotic-resistant organisms. ***Conclusion*:** The incidence of SSIs in elective laparoscopic cholecystectomy was 10%, with diabetes, obesity, and prolonged operative time being significant risk factors. Prophylactic antibiotic use was effective in reducing infection rates. Identifying high-risk patients can help tailor preventative strategies to reduce SSI incidence.

Keywords: Laparoscopic cholecystectomy, surgical site infection, risk factors, obesity, diabetes, prophylactic antibiotics.

INTRODUCTION

Laparoscopic cholecystectomy is one of the most commonly performed surgical procedures for the treatment of symptomatic gallstones and other biliary disorders [1]. It is widely favored due to its minimally invasive nature, reduced postoperative pain, shorter hospital stays, and quicker recovery times compared to open cholecystectomy [2]. Despite its advantages, complications such as surgical site infections (SSIs) remain a concern. SSIs can lead to increased morbidity, prolonged hospital stays, additional treatment costs, and, in severe cases, further surgical intervention [3, 4].

The incidence of SSIs after laparoscopic procedures is generally lower than in open surgeries, but it is not negligible. Various factors, including patient comorbidities, surgical technique, and operative conditions, can contribute to the development of infections [5, 6]. Specifically, diabetes, obesity, smoking, and prolonged operative time have been frequently identified as risk factors for SSIs in surgical literature. Additionally, the proper administration of prophylactic antibiotics has been shown to reduce infection rates, though the optimal use of such interventions continues to be an area of study [7].

This prospective observational study aims to evaluate the incidence of SSIs in patients undergoing elective laparoscopic cholecystectomy and to identify the specific risk factors contributing to the development of these infections. By understanding these risk factors, we aim to provide better preventive strategies, optimize the use of antibiotics, and ultimately improve surgical outcomes for patients undergoing this common procedure.

Methodology:

This prospective observational study was conducted at GMERS Medical College, Gandhinagar, over a period of one year, from April 2022 to March 2023. A total of 50 patients undergoing elective laparoscopic cholecystectomy were included in the study. The study aimed to assess the incidence of surgical site infections (SSIs) and identify associated risk factors in this patient population.

Study Population:

Inclusion criteria for the study were as follows:

- Adult patients (aged 18 years and above) scheduled for elective laparoscopic cholecystectomy.
- Patients who consented to participate in the study.
- Exclusion criteria included:
- Emergency cholecystectomy procedures.
- Patients with pre-existing infections or on long-term antibiotics.
- Patients with incomplete follow-up data.

Data Collection:

Demographic data (age, gender, body mass index [BMI]), comorbidities (e.g., diabetes, hypertension), and smoking history were recorded. Intraoperative data, including the duration of surgery, use of prophylactic antibiotics, and the need for conversion to open surgery, were also documented. Postoperatively, patients were followed up for 30 days to monitor the development of SSIs. SSIs were classified as:

- Superficial incisional infections.
- Deep incisional infections.
- Organ/space infections.

Interventions:

All patients received standardized preoperative care, including the use of prophylactic antibiotics as per institutional protocols. The antibiotic used was cefazolin, administered 30–60 minutes before the incision.

Outcome Measures:

The primary outcome was the incidence of SSIs, determined according to Centers for Disease Control and Prevention (CDC) criteria. Secondary outcomes included identifying risk factors for SSIs, such as diabetes, obesity (BMI >30), smoking, and prolonged operative time (>120 minutes). Data on microbiological findings in patients with SSIs were also collected.

Statistical Analysis:

Descriptive statistics were used to summarize patient characteristics and infection rates. Risk factors for SSIs were analyzed using chi-square tests, and p-values <0.05 were considered statistically significant. All analyses were performed using SPSS software.

Ethical Considerations:

This study was conducted following the ethical guidelines laid down by the institutional ethics committee of GMERS Medical College, Gandhinagar. Written informed consent was obtained from all participants before enrollment in the study.

RESULTS

A total of 50 patients who underwent elective laparoscopic cholecystectomy were included in this study. The results are organized into key areas, including patient demographics, surgical details, surgical site infection (SSI) rates, risk factors for SSIs, and microbiological findings.

Demographics

The study cohort included 20 males (40%) and 30 females (60%), with a mean age of 45.6 years (range: 20–70). The average BMI was 28.3 kg/m² (range: 22–35). Among the patients, 10 (20%) had diabetes, 12 (24%) had hypertension, and 8 (16%) had a smoking history (Table 1).

Surgical Details

The average operative time was 90 minutes, ranging from 60 to 150 minutes. Two patients (4%) required conversion to open surgery. Prophylactic antibiotics were administered in 45 patients (90%). The median length of hospital stay was 2 days (range: 1–5 days) (Table 2).

Surgical Site Infection Rates

The overall incidence of SSIs was 10%, with 5 patients developing infections. Of these, 3 patients (6%) had superficial infections, 1 patient (2%) developed a deep incisional infection, and 1 patient (2%) had an organ/space infection. SSIs typically presented within an average of 7 days postoperatively (Table 3).

Risk Factors for Surgical Site Infections

Among the identified risk factors, diabetes was significantly associated with the development of SSIs, with 3 out of 10 diabetic patients (30%) developing infections ($p = 0.02$). Obesity (BMI >30) was also a significant factor, as 3 out of 12 patients (25%) with obesity developed SSIs ($p = 0.03$). Prolonged operative time (>120 minutes) was associated with a 33.3% infection rate ($p = 0.01$). Smoking showed a trend towards increased risk, with 2 out of 8 patients (25%) developing SSIs, although this was not statistically significant ($p = 0.08$) (Table 4).

Microbiological Findings

The most commonly isolated pathogens were *Escherichia coli* (2 cases), *Staphylococcus aureus* (2 cases), and *Klebsiella pneumoniae* (1 case). Two of the pathogens showed resistance to first-line prophylactic antibiotics, requiring modifications in the postoperative antibiotic regimen (Table 5).

Management and Outcomes of SSIs

All superficial infections were treated successfully with oral antibiotics and local wound care. One patient with a deep incisional infection required debridement and intravenous antibiotics. The patient with an organ/space infection underwent percutaneous drainage. All patients recovered within 3 weeks, and no mortalities were reported.

Table 1: DemographicCharacteristics of Patients Undergoing Elective Laparoscopic Cholecystectomy (n=50)

Characteristic	Values
Gender (Male/Female)	20/30
Mean Age (years)	45.6 (20-70)
BMI (kg/m²)	28.3 (22-35)
Diabetes	10 (20%)
Hypertension	12 (24%)
Smoking History	8 (16%)

Table 2: Surgical Details of Patients Undergoing Elective Laparoscopic Cholecystectomy

Characteristic	Values
Average Operative Time (minutes)	90 (60-150)
Conversion to Open Surgery	2 (4%)
Prophylactic Antibiotics	45 (90%)
Hospital Stay (days)	2 (1-5)

Table 3: Incidence of Surgical Site Infections in Patients Undergoing Elective Laparoscopic Cholecystectomy

SSI Type	Number of Patients (%)
Total SSIs	5 (10%)
Superficial Infections	3 (6%)
Deep Incisional Infections	1 (2%)
Organ/Space Infections	1 (2%)

Table 4: Risk Factors Associated with Surgical Site Infections in Patients Undergoing Elective Laparoscopic Cholecystectomy

Risk Factor	Number of Patients with SSIs (%)	P-value
Diabetes	3 (30%)	0.02
BMI >30	3 (25%)	0.03
Prolonged Operative Time (>120 min)	2 (33.3%)	0.01
Smoking	2 (25%)	0.08

Table 5: Microbiological Findings

Pathogen	Number of Cases
Escherichia coli	2
Staphylococcus aureus	2
Klebsiella pneumoniae	1

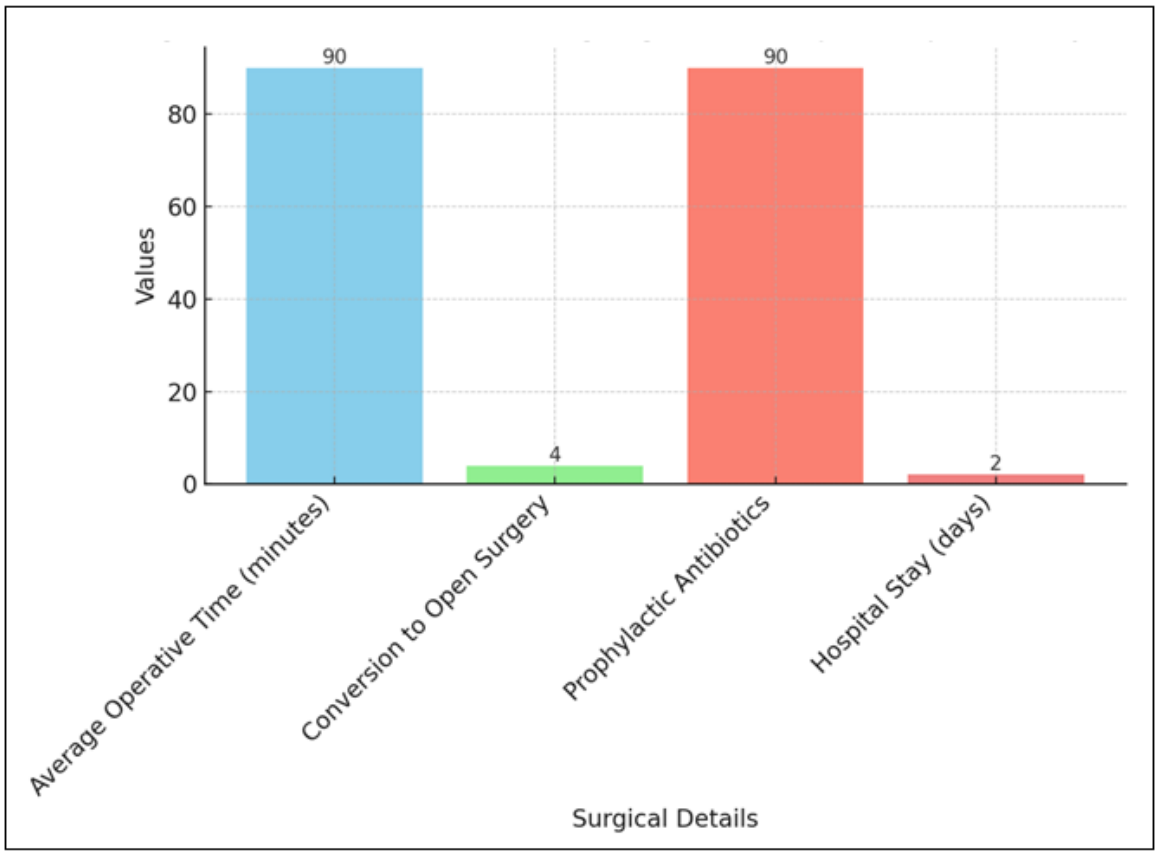

Figure 1: Surgical Details of Patients Undergoing Elective Laparoscopic Cholecystectomy

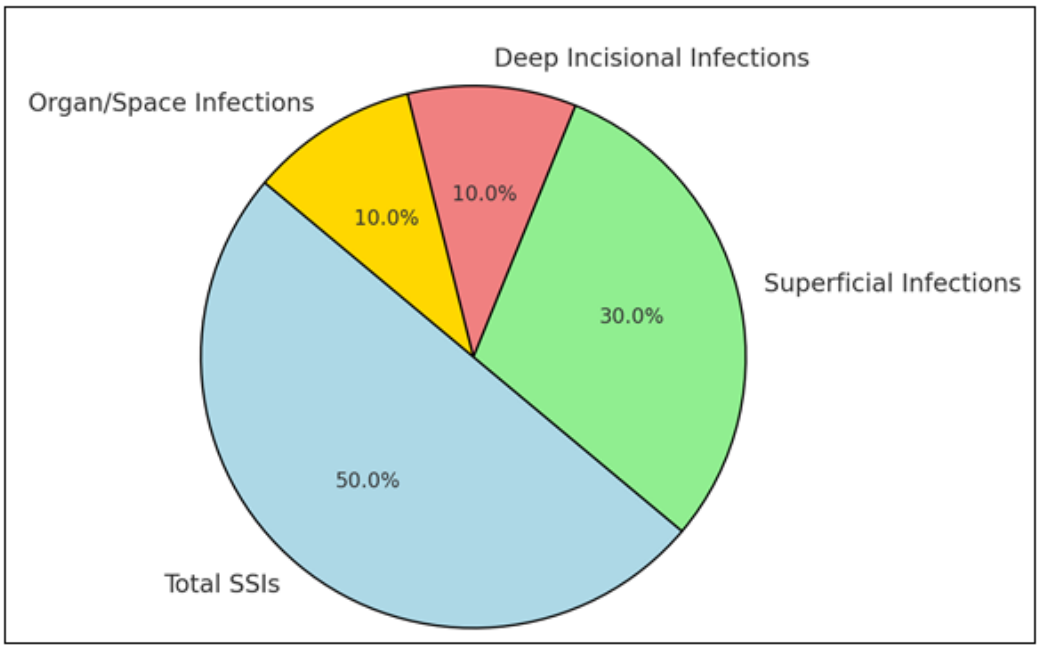

Figure 2: Incidence of Surgical Site Infections in Patients Undergoing Elective Laparoscopic Cholecystectomy

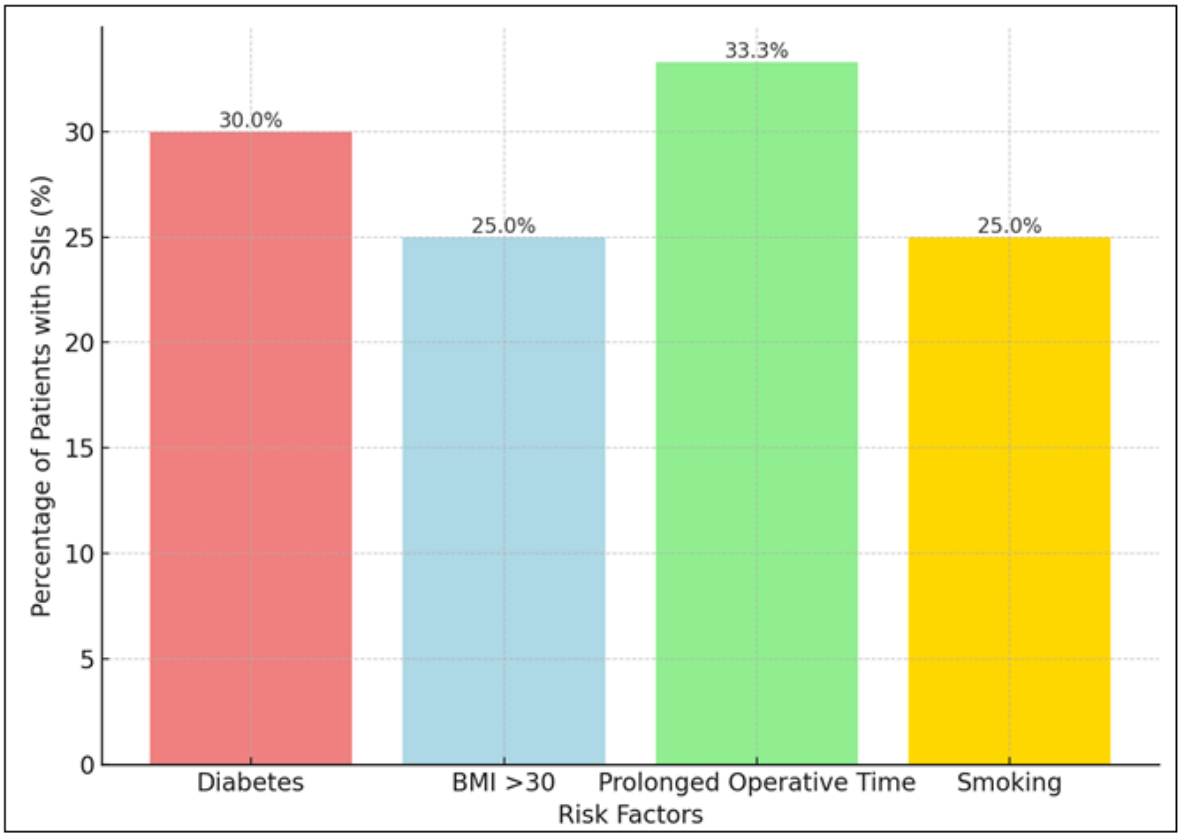

Figure 3: Risk Factors Associated with Surgical Site Infections in Patients Undergoing Elective Laparoscopic Cholecystectomy

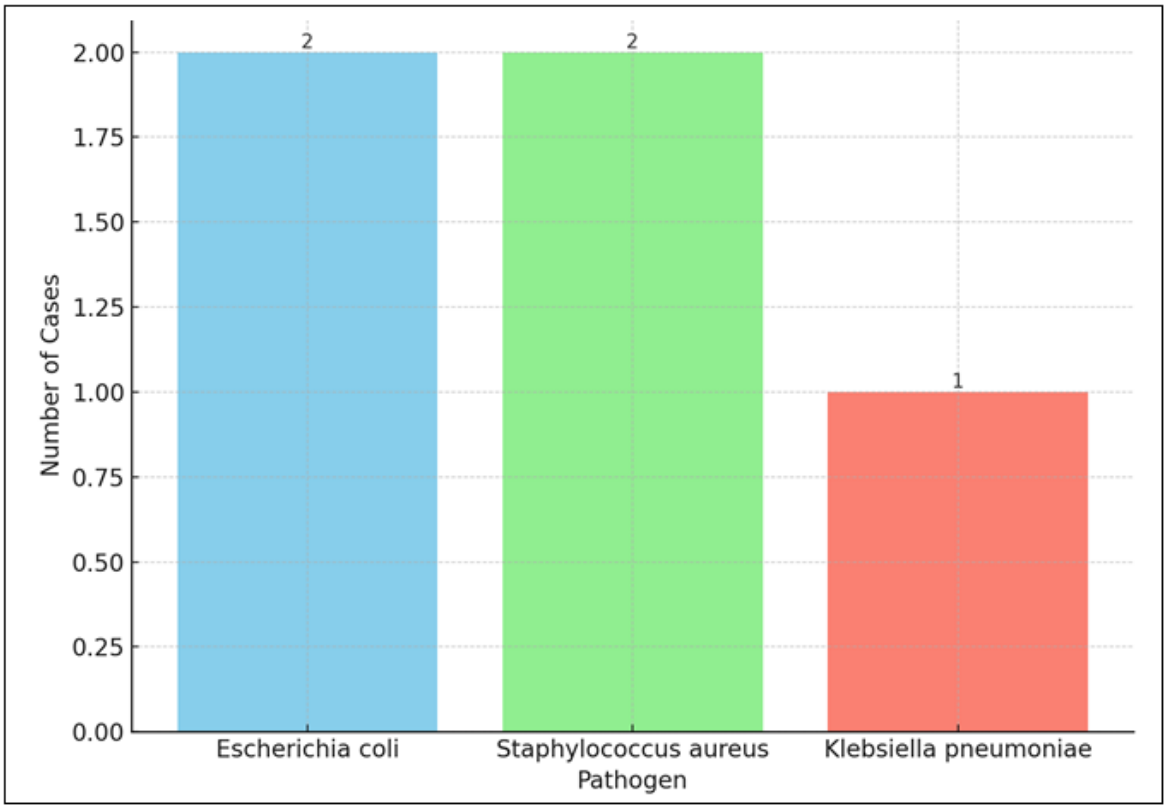

Figure 4: Microbiological Findings in Patients with Surgical Site Infections

DISCUSSION

This prospective observational study aimed to assess the incidence of surgical site infections (SSIs) in patients undergoing elective laparoscopic cholecystectomy and to identify associated risk factors. Our findings revealed an overall SSI rate of 10%, consistent with previously reported rates for laparoscopic surgeries. Several significant risk factors were identified, including diabetes, obesity, and prolonged operative time, which align with findings from other studies (Warren *et al*., 2017 [8]; Gamo *et al*., 2022) [9].

Incidence of SSIs:

The overall incidence of SSIs (10%) in this study falls within the range of 5% to 15% reported in the literature for laparoscopic cholecystectomy (Warren *et al*., 2017) [8]. Although laparoscopic procedures typically result in lower infection rates compared to open surgeries, SSIs remain a significant complication. Other studies have similarly shown that laparoscopic procedures are not immune to infection risks, particularly when patient-specific factors come into play (Hajong *et al*., 2021) [12].

Risk Factors for SSIs:

Several patient and surgical factors were significantly associated with the development of SSIs:

Diabetes: In this study, 30% of diabetic patients developed SSIs, a finding consistent with previous research showing diabetes as a major risk factor due to impaired immune response and delayed wound healing (Warren *et al*., 2017 [8]; Hajong *et al*., 2021) [12]. Proper glycemic control is essential to mitigate this risk.

Obesity: Obesity (BMI >30) was identified as a significant predictor of SSIs, with 25% of obese patients affected ($p = 0.03$). This is supported by studies that have shown obesity increases the risk of SSIs due to poor tissue perfusion and longer operative times (Gamo *et al*., 2022) [9]. Similar trends have been reported in other studies on abdominal surgeries (Jatoliya *et al*., 2023) [10].

Prolonged Operative Time: Patients with operative times exceeding 120 minutes had a 33.3% incidence of SSIs ($p = 0.01$), supporting evidence from previous studies that link longer operative times to higher infection rates (Warren *et al*., 2017) [8]. Prolonged surgeries increase the risk due to greater tissue exposure and the potential for contamination (Ashoobi *et al*., 2023) [14].

Smoking: Although smoking did not reach statistical significance ($p = 0.08$), there was a trend towards increased infection risk. Smoking is a well-known factor for impaired wound healing and has been associated with higher SSI rates in various procedures (Opoien *et al*., 2007 [11]; Hajong *et al*., 2021) [12]. Smoking cessation prior to elective surgeries should be strongly encouraged.

Microbiological Findings:

The most commonly isolated pathogens in this study were *Escherichia coli*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*. This is consistent with other studies that have identified similar pathogens in surgical infections (Gamo *et al*., 2022) [9]. Two infections involved antibiotic-resistant strains, emphasizing the need for careful selection of prophylactic antibiotics and monitoring antibiotic resistance patterns (Marzoug *et al*., 2023) [13].

Clinical Implications:

This study underscores the importance of addressing modifiable risk factors in patients undergoing elective laparoscopic cholecystectomy. Preoperative optimization of diabetic control, weight management for obese patients, and smoking cessation should be prioritized. In addition, strategies to minimize operative time and adhere to infection prevention protocols are crucial for improving surgical outcomes.

LIMITATIONS

This study had a relatively small sample size of 50 patients, which may limit the generalizability of the findings. Larger, multi-center studies are needed to confirm these results. Furthermore, while this study identified several risk factors for SSIs, it did not assess other potential contributing factors, such as the surgeon's experience, intraoperative ventilation, or wound closure techniques.

CONCLUSION

This study demonstrated a 10% incidence of surgical site infections (SSIs) following elective laparoscopic cholecystectomy, with significant risk factors including diabetes, obesity (BMI >30), and prolonged operative time (>120 minutes). Diabetic and obese patients were particularly susceptible to infections, emphasizing the need for preoperative optimization in these populations. The use of prophylactic antibiotics effectively reduced infection rates, though two cases involved antibiotic-resistant pathogens, highlighting the importance of antibiotic stewardship. Targeted interventions, such as glycemic control and weight management, along with minimizing operative time, are essential strategies to further reduce SSIs and improve patient outcomes.

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