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Original Research Article

Association between preoperative factors and surgical site infection following elective abdominal wall hernia repair: a retrospective observational study

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ABSTRACT

Background: Surgical site infection (SSI) is one of the most common healthcare-associated infections and remains a major cause of postoperative morbidity, prolonged hospital stay, and increased healthcare costs. Identifying preoperative risk factors may improve perioperative strategies aimed at reducing SSI after elective abdominal wall hernia repair. This study evaluated the association between preoperative factors and the occurrence of SSI in adult patients undergoing elective hernia repair.
Methods: A retrospective, observational, analytical, cross-sectional study was conducted at the General Surgery Department of Hospital General de Zona No. 20 "La Margarita", Instituto Mexicano del Seguro Social (IMSS), Puebla, Mexico. Medical records of adult patients who underwent elective abdominal wall hernia repair between January and December 2023 were reviewed. Demographic characteristics, body mass index (BMI), smoking status, glycated hemoglobin (HbA1c), American Society of Anesthesiologists (ASA) physical status classification, and type of hernia repair were analyzed. Associations with SSI were evaluated using Pearson's chi-square test, Kendall's Tau, and odds ratios (ORs) with 95% confidence intervals (95% CI). Statistical significance was established at $p<0.05$.
Results: Eighty patients met the inclusion criteria. The median age was 34 years, and 58.8% were male. The annual prevalence of SSI was 1.5%, whereas 19 patients (23.8%) developed postoperative SSI within the study cohort. Overweight was significantly associated with SSI ($p=0.030$). Inguinal hernia repair was independently associated with a substantially higher risk of SSI (OR 18.6; 95% CI 2.3–24.8; $p<0.001$). No significant associations were observed for age, smoking status, HbA1c, or ASA classification.
Conclusions: Overweight and inguinal hernia repair were the principal preoperative factors associated with SSI in this cohort. These findings emphasize the importance of preoperative risk assessment and optimization, particularly in overweight patients and those undergoing inguinal hernia repair, to reduce postoperative infectious complications.

Keywords: Surgical site infection, Hernia repair, Preoperative risk factors, Body mass index, Inguinal hernia, Elective surgery

INTRODUCTION

Surgical site infection (SSI) is one of the most frequent healthcare-associated infections and remains a major cause of postoperative morbidity worldwide. It is associated with delayed wound healing, prolonged hospitalization, increased healthcare costs, reoperations, and reduced quality of life. Despite advances in surgical techniques, perioperative care, and infection prevention strategies, SSI continues to represent a significant

challenge for healthcare systems, particularly in general surgery.[1,2] Abdominal wall hernia repair is among the most commonly performed procedures in general surgery, with millions of operations carried out annually worldwide. Although elective hernia repair is generally considered a clean surgical procedure, postoperative SSI remains a relevant complication because it may compromise wound healing, increase the risk of hernia recurrence, and, in patients receiving prosthetic mesh, require prolonged antimicrobial therapy or even mesh removal.[3,4] Consequently, identifying patients at increased risk before surgery has become an important component of perioperative management.

The development of SSI is a multifactorial process involving interactions between patient-related, procedural, and environmental factors. Among preoperative patient characteristics, obesity, diabetes mellitus, smoking, advanced age, poor nutritional status, and high anesthetic risk have been consistently investigated as potential predictors of postoperative infection. Excess adipose tissue has been associated with impaired tissue perfusion, increased dead space, and delayed wound healing, whereas poor glycemic control may impair immune function and collagen synthesis, thereby increasing susceptibility to infection. Likewise, tobacco exposure has been linked to microvascular dysfunction and reduced tissue oxygenation, negatively affecting surgical wound healing.[5-7]

Although several international studies have evaluated risk factors for SSI following hernia repair, their findings have not always been consistent. Differences in patient populations, surgical techniques, perioperative antibiotic protocols, and healthcare settings may explain the variability observed across studies. Furthermore, most available evidence originates from high-income countries, while information from Latin American populations, particularly within the Mexican healthcare system, remains limited. Local epidemiological data are essential because patient characteristics, prevalence of comorbidities, and institutional practices may differ substantially from those reported elsewhere.[8,9]

Within the Instituto Mexicano del Seguro Social (IMSS), elective abdominal wall hernia repair is routinely performed, making SSI prevention a priority to improve patient outcomes and optimize healthcare resources.[10] Identifying modifiable preoperative risk factors may facilitate the implementation of targeted preventive strategies, improve perioperative decision-making, and reduce postoperative infectious complications.[11] Therefore, the aim of this study was to evaluate the association between preoperative factors and the occurrence of surgical site infection in adult patients undergoing elective abdominal wall hernia repair at Hospital General de Zona No. 20 "La Margarita", Instituto Mexicano del Seguro Social, Puebla, Mexico.

METHODS

Study design and setting

A retrospective, observational, analytical, cross-sectional, single-center study was conducted at the Department of General Surgery of Hospital General de Zona No. 20 "La Margarita", Instituto Mexicano del Seguro Social (IMSS), Puebla, Mexico. The study included patients who underwent elective abdominal wall hernia repair between January 1 and December 31, 2023. The study protocol was approved by the Local Research and Ethics Committee before data collection.

Study population

The study population consisted of adult patients who underwent elective abdominal wall hernia repair during the study period. Medical records were reviewed retrospectively to identify eligible participants. A total of 1,247 elective hernia repair procedures were performed during the study period. Of these, 120 patients fulfilled the eligibility criteria, and after excluding incomplete medical records, 80 patients were included in the final analysis.

Eligibility criteria

Inclusion criteria

Patients were eligible if they: were between 25 and 65 years of age; underwent elective abdominal wall hernia repair at Hospital General de Zona No. 20 during the study period; had complete clinical records available for review.

Exclusion criteria

Patients were excluded if they had: previous intra-abdominal surgical procedures; peritoneal dialysis; chronic kidney disease; liver cirrhosis; human immunodeficiency virus infection; congenital or acquired immunodeficiency disorders.

Elimination criteria

Medical records with incomplete clinical information were excluded from the analysis.

Variables

The primary outcome was the occurrence of surgical site infection (SSI), diagnosed according to clinical findings documented in the medical records during postoperative follow-up.

The preoperative variables analyzed included: age, sex, body mass index (BMI), smoking status, glycated hemoglobin (HbA1c), American Society of

Anesthesiologists (ASA) physical status classification, and type of hernia repair.

Data collection

Clinical data were obtained through a retrospective review of electronic and paper medical records using a standardized data collection form developed for the study. All information was collected by the principal investigator. Patient identifiers were removed before analysis to preserve confidentiality. Data quality was verified before statistical analysis by reviewing incomplete or inconsistent records.

Statistical analysis

Continuous variables were summarized as median and interquartile range (IQR) or mean±standard deviation, depending on data distribution. Categorical variables were expressed as frequencies and percentages.

Normality was assessed using the Kolmogorov–Smirnov test. Associations between categorical variables were evaluated using Pearson's chi-square test, whereas Kendall's Tau-C test was used for ordinal variables. Odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated to estimate the association between preoperative factors and SSI. A two-sided $p<0.05$ was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics version 30.0 (IBM Corp., Armonk, NY, USA).

Ethical considerations

The study was approved by the Local Research and Ethics Committee of the Instituto Mexicano del Seguro Social. Owing to the retrospective nature of the study, only existing clinical records were reviewed. Patient confidentiality was maintained throughout the study by anonymizing all personal identifiers before data analysis. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the Mexican General Health Law on Health Research.

RESULTS

A total of 1,247 elective abdominal wall hernia repairs were performed during the study period. After applying the eligibility criteria, 80 patients were included in the final analysis. The overall institutional prevalence of surgical site infection (SSI) was 1.5%, while 19 patients (23.8%) within the study cohort developed postoperative SSI.

The median age of the study population was 34 years (interquartile range, 29-46 years), and 47 patients (58.8%) were male. Regarding nutritional status, overweight and obesity were frequent among patients who developed SSI. Most participants were classified as ASA I or II, and the majority had normal glycated hemoglobin values (<5.7%). Baseline demographic and clinical characteristics are summarized in Table 1.

Table 1: Baseline characteristics of the study population.

Variables	Values
Total patients	80
Median age (years)	34
Male sex	47 (58.8%)
Female sex	33 (41.2%)
Surgical site infection (SSI)	19 (23.8%)
No surgical site infection	61 (76.2%)
Institutional SSI prevalence	1.5%

SSI=surgical site infection.

Table 2: Association between preoperative factors and surgical site infection.

Variables	P value
Body mass index	0.030
Age	>0.05
HbA1c	0.287
Smoking	0.755
ASA classification	--

Analysis of preoperative factors demonstrated a statistically significant association between body mass index (BMI) and the occurrence of SSI. Patients with overweight had a significantly higher frequency of postoperative infection than patients with normal BMI ($p=0.030$). No, statistically significant associations were observed between SSI and age, glycated hemoglobin (HbA1c), smoking status, or ASA physical status classification ($p>0.05$ for all comparisons) (Table 2).

Table 3: Odds ratios for preoperative factors associated with surgical site infection.

Variables	OR (95% CI)	P value
Inguinal hernia repair	18.6 (2.3–24.8)	<0.001
Elevated BMI	0.48 (0.15–1.50)	0.203
HbA1c ≥5.7%	1.77 (0.61–5.10)	0.287
ASA ≥III	0.81 (0.27–2.40)	0.720
Smoking	1.04 (0.78–1.38)	0.755

The type of hernia repair was also significantly associated with postoperative SSI. Among patients who developed infection, 18 of 19 (94.7%) had undergone inguinal hernia repair, whereas only one infection occurred after another type of abdominal wall hernia repair. Patients undergoing inguinal hernia repair had an 18.6-fold greater likelihood of developing SSI than those undergoing other elective hernia procedures (OR 18.6; 95% CI 2.3–24.8; $p<0.001$) (Table 3).

No, statistically significant associations were identified between SSI and elevated glycated hemoglobin (OR 1.77; 95% CI 0.61–5.10; p=0.287), elevated ASA physical status (OR 0.81; 95% CI 0.27–2.40; p=0.720), smoking status (OR 1.04; 95% CI 0.78–1.38; p=0.755), or increased BMI when analyzed as a dichotomous variable in the odds ratio model (OR 0.48; 95% CI 0.15–1.50; p=0.203) (Table 3).

Overall, overweight and the performance of inguinal hernia repair were the only preoperative variables associated with an increased risk of postoperative SSI in this cohort. No significant associations were observed for the remaining demographic or clinical variables evaluated.

DISCUSSION

Surgical site infection (SSI) remains an important postoperative complication associated with increased morbidity, prolonged hospitalization, and healthcare costs. Identifying preoperative factors associated with SSI is essential for improving perioperative risk assessment and implementing preventive strategies. In the present study, the frequency of SSI was 23.8% (19/80) among the analyzed patients, whereas the overall institutional prevalence was 1.5%. These findings should be interpreted separately because they represent different denominators: the selected study cohort and the total number of elective hernia repairs performed during the study period.

Regarding age, no statistically significant association with SSI was identified in the present study (p>0.05). Chronological age should be interpreted in the context of other patient-related factors, including comorbidities and physiological status. Therefore, the absence of a significant association in our cohort does not necessarily exclude a potential contribution of age to postoperative infectious complications. With respect to sex, no statistically significant association with SSI was identified. The relationship between sex and postoperative infection may vary according to the type of surgical procedure, patient characteristics and associated comorbidities. In our population, sex alone did not demonstrate a significant association with the occurrence of SSI.

Body mass index (BMI) showed a statistically significant association with SSI in the initial categorical analysis (p=0.030). This finding is consistent with the study by Poelemeijer et al which evaluated obesity as a risk factor for surgical site infection following abdominal wall hernia repair.[8] Excess adipose tissue may contribute to impaired tissue perfusion, reduced oxygenation, increased wound tension, and delayed wound healing. These mechanisms may partially explain the relationship between nutritional status and postoperative infectious complications. However, in our odds-ratio analysis, elevated BMI was not significantly associated with SSI (OR 0.48; 95% CI, 0.15–1.50; p=0.203). This discrepancy may be related to differences in variable categorization and the limited sample size. Consequently, BMI should not be considered an independent predictor based on the present findings.

Regarding glycemic control, elevated HbA1c levels were not significantly associated with SSI (OR 1.77; 95% CI, 0.61–5.10; p=0.287). This finding should be interpreted cautiously because previous evidence has identified diabetes mellitus as an important risk factor for surgical site infection. Martin et al reported an association between diabetes and SSI in their systematic review and meta-analysis.[9] The lack of statistical significance in our cohort may be explained by the relatively small sample size, the distribution of HbA1c values, or adequate preoperative metabolic control among the included patients.

Smoking was not significantly associated with SSI in the present study (OR 1.04; 95% CI, 0.78–1.38; p=0.755). Nevertheless, tobacco exposure is recognized as a relevant factor in perioperative risk assessment because of its effects on tissue oxygenation and wound healing. Nolan and Warner reviewed the relationship between perioperative tobacco use and postoperative complications.[10] The absence of a statistically significant association in our cohort should not be interpreted as evidence that smoking has no biological effect on wound healing, particularly considering the limited sample size and the possibility of differences in smoking exposure.

The American Society of Anesthesiologists (ASA) physical status classification was not significantly associated with SSI in our study (OR 0.81; 95% CI, 0.27–2.40; p=0.720). This finding may be related to the characteristics of an elective surgical population, in which patients generally undergo preoperative assessment and optimization. However, the relatively small sample size limits the ability to identify associations involving variables with fewer observations.

An important finding was the higher frequency of SSI among patients undergoing inguinal hernia repair. Inguinal hernia repair was associated with higher odds of SSI compared with other elective abdominal wall hernia procedures (OR 18.6; 95% CI, 2.3–24.8; p<0.001). Köckerling and Simons described differences in surgical approaches and outcomes in inguinal hernia repair, highlighting the relevance of anatomical and technical considerations in the management of these patients.[7] However, the association observed in our study should be interpreted cautiously because the confidence interval was wide and the number of infection events was limited. Furthermore, the observed association does not establish that the inguinal location itself causes an increased risk of infection; unmeasured procedural and patient-related factors may have influenced this result.

Overall, the findings suggest that SSI following elective abdominal wall hernia repair is multifactorial. Although BMI demonstrated a significant association in the initial analysis, this finding was not confirmed in the odds-ratio analysis. In contrast, inguinal hernia repair showed a statistically significant association with SSI. Age, sex, HbA1c, smoking and ASA classification were not significantly associated with the outcome in this cohort. These findings support the importance of individualized preoperative assessment and consideration of procedure-specific characteristics when evaluating the risk of postoperative infection.

Limitations

This study has several limitations. Its retrospective design limits the ability to establish causal relationships between the evaluated factors and SSI. The relatively small sample size may have reduced statistical power and increased the possibility of type II error. In addition, the study relied on information recorded in clinical records, which may have resulted in incomplete or heterogeneous documentation of variables such as smoking status and metabolic control. The single-center nature of the study also limits the generalizability of the findings. Finally, the association between inguinal hernia repair and SSI should be interpreted cautiously because of the wide confidence interval and the possibility of residual confounding related to surgical technique and other procedure-specific factors. Prospective, multicenter studies with larger sample sizes are warranted to validate these findings.

CONCLUSION

In conclusion, this study identified a significant association between inguinal hernia repair and surgical site infection, while age, HbA1c, smoking and ASA classification were not significantly associated with SSI in the evaluated population. Although BMI was associated with SSI in the initial analysis, this association was not confirmed in the odds-ratio analysis, underscoring the importance of interpreting findings according to the statistical model used. These results contribute to the understanding of SSI risk in elective hernia surgery by emphasizing the potential relevance of procedure-specific characteristics in addition to conventional patient-related factors. The findings may support more individualized preoperative risk assessment and targeted preventive strategies, while also providing a basis for future prospective and multicenter studies aimed at validating these associations and identifying modifiable risk factors for SSI.

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