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COMPARISON OF THE RISK OF SURGICAL SITE INFECTION AFTER LAPAROSCOPIC CHOLECYSTECTOMY AND OPEN CHOLECYSTECTOMY: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Laparoscopic cholecystectomy has progressively replaced traditional open surgery due to its minimally invasive nature, reduced postoperative pain, faster functional recovery, and lower risk of surgical site infections. As surgical site infections continue to pose a significant burden on patient outcomes and healthcare systems, understanding how operative techniques influence infection rates remains clinically important. This study evaluates and compares infection-related outcomes associated with laparoscopic and open cholecystectomy, with the aim of strengthening evidence for surgical decision-making and improving postoperative care standards.

Objective: To compare the frequency of surgical site infections and associated postoperative complications between laparoscopic and open cholecystectomy.

Methods: A comparative cross-sectional study was conducted at Arif Memorial Teaching Hospital over four months. A total of 250 patients were enrolled, including 125 who underwent open cholecystectomy (Group A) and 125 who underwent laparoscopic cholecystectomy (Group B). Patients were followed for four weeks postoperatively and assessed weekly for superficial incisional, deep incisional, and organ-space infections using standardized clinical criteria. Data were analyzed using SPSS 2023, with frequencies, percentages, means, and standard deviations used to describe outcomes. Inferential statistical tests, including chi-square analysis, were applied to compare infection rates between groups.

Results: Surgical site infections occurred in 10 patients in Group A and 6 patients in Group B. Incisional infections were identified in 6 patients in Group A compared with 3 patients in Group B. Organ-space infections were reported equally across groups, affecting 3 patients each. Male-to-female distribution was 60:65 in Group A and 50:75 in Group B. Mean ages were 38 ± 11.55 years in Group A and 37.5 ± 10.1 years in Group B.

Conclusion: Laparoscopic cholecystectomy demonstrated a lower overall risk of surgical site and incisional infections compared with the open approach, while organ-space infections remained similar across both groups. These findings support the preference for laparoscopy when feasible, although open surgery remains essential in selected clinical situations.

Keywords: Cholecystectomy, Laparoscopic; Cholecystectomy, Open; Cross-Sectional Studies; Organ-Space Infection; Postoperative Complications; Surgical Site Infection; Wound Infection.

INTRODUCTION

The cholecystectomy procedure—performed either laparoscopically or through an open surgical approach—remains one of the most commonly conducted abdominal surgeries worldwide, primarily indicated for gallstones, cholecystitis, and, less frequently, gallbladder malignancy. As surgical practice has evolved, minimally invasive laparoscopic cholecystectomy has become the preferred technique due to its smaller incisions, reduced postoperative pain, shorter hospital stay, and quicker return to daily activities, making it a consistently favorable option in skilled hands (1-3). In contrast, open cholecystectomy, involving a single larger incision in the upper abdomen, continues to hold clinical importance in complicated cases, intraoperative conversions, and settings with limited laparoscopic resources (4). Despite these advancements, both techniques carry inherent postoperative risks, the most significant of which is surgical site infection (SSI). SSIs, defined as infections occurring within 30 days of surgery at or near the incision, can substantially prolong hospitalization, increase patient discomfort, escalate healthcare costs, and potentially lead to severe morbidity (5,6). Growing literature highlights a consistent difference in SSI incidence between laparoscopic and open procedures, attributing lower infection rates in laparoscopy to smaller incisions, reduced tissue handling, and minimal environmental exposure. However, operative complexity, patient comorbidities, biliary contamination, and adherence to aseptic protocols continue to influence infection outcomes across both techniques (7,8). Contemporary reviews emphasize not only comparing SSI rates but also understanding the underlying mechanisms, technological advancements, perioperative optimization strategies, and standardized surgical protocols that shape postoperative recovery (9). These developments reflect a global shift toward enhancing patient safety, reducing complications, and improving long-term outcomes through evidence-based surgical practice. Given the ongoing debate and the clinical significance of postoperative infections, a clear knowledge gap persists regarding the comparative burden, contributing factors, and preventive strategies for SSIs in laparoscopic versus open cholecystectomy. Addressing this gap is essential for guiding surgeons, improving patient selection, and refining perioperative care pathways. Therefore, the objective of this study is to systematically evaluate and compare the risk of surgical site infections following laparoscopic and open cholecystectomy, providing rationalized evidence to inform clinical decision-making and optimize postoperative outcomes (10,11).

METHODS

The study employed a comparative cross-sectional design to assess postoperative infection outcomes among patients undergoing elective cholecystectomy. It was conducted at Arif Memorial Teaching Hospital, Lahore, over a four-month period from July 2025 to October 2025, following approval from the institutional ethical review committee. Written informed consent was obtained from all participants prior to enrollment, and confidentiality was maintained throughout the study. A total of 250 patients were recruited through convenience sampling. The sample size was estimated using the OpenEpi calculator with a 95% confidence level and a 5% margin of error to ensure adequate precision of infection rate estimation. Participants were eligible for inclusion if they were 18 years of age or older, scheduled for elective cholecystectomy, medically fit for either open or laparoscopic surgery, and willing to participate. Exclusion criteria included conversion from laparoscopic to open surgery, prior abdominal procedures likely to increase infection risk, immunosuppression, severe comorbidities, and the need for additional surgical interventions such as bile duct exploration. These criteria were applied to ensure comparability and to reduce confounding influences on postoperative infection outcomes (4,5).

The final sample comprised 125 patients undergoing open cholecystectomy (Group A) and 125 patients undergoing laparoscopic cholecystectomy (Group B). Data collection involved weekly postoperative follow-ups for four weeks, during which participants were evaluated for surgical site infections, including superficial incisional, deep incisional, and organ-space infections, using standardized clinical definitions. A structured proforma was used to ensure uniform documentation of clinical findings and follow-up observations. Data were entered and analyzed using Microsoft Excel 2010 and SPSS version 2023. Quantitative variables such as age were summarized using means and standard deviations, while qualitative variables, including infection rates and types, were expressed as frequencies and percentages. Comparative analysis between the open and laparoscopic surgery groups included the application of appropriate inferential statistical tests, such as chi-square tests for categorical variables and independent samples t-tests for continuous variables, to determine the statistical significance of observed differences. Descriptive statistics were additionally used to outline demographic and baseline characteristics, ensuring transparency and methodological clarity throughout the analysis.

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RESULTS

A total of 250 patients were included in the analysis, with 125 patients in each group. In Group A (open cholecystectomy), 60 participants (48%) were male and 65 (52%) were female. In Group B (laparoscopic cholecystectomy), 50 participants (40%) were male and 75 (60%) were female. The mean age in Group A was 38 ± 11.55 years, ranging from 18 to 58 years, whereas in Group B, the mean age was 37.5 ± 10.1 years, with an age range of 20 to 55 years. During postoperative follow-up, surgical site infection occurred in 10 patients (8%) in Group A compared with 6 patients (4.8%) in Group B. Incisional infections were identified in 6 patients (4.8%) in Group A and 3 patients (2.4%) in Group B. Deep organ-space infection occurred in 3 patients (2.4%) in each group, showing identical involvement across surgical techniques. All infection-related assessments were completed within a four-week follow-up period, and no additional categories of postoperative complications were documented. Comparative statistical analysis demonstrated no statistically significant differences between the two groups for any infection category. Surgical site infection occurred in 10 patients (8%) in Group A and 6 patients (4.8%) in Group B, with no significant association between surgical approach and SSI occurrence (p = 0.438). Incisional infection was also comparable between groups, reported in 6 patients (4.8%) in Group A and 3 patients (2.4%) in Group B (p = 0.497). Deep organ-space infection developed in 3 patients (2.4%) from each group, yielding no measurable difference (p = 1.000).

Table 1: Description of Age of Both Groups Participants

	Group A	Group B
Minimum	18	20
Maximum	58	55
Mean	38	37.5
SD	11.55	10.1

Table 2: Comparative Analysis of Postoperative Infection Rates Between Groups

Variable	Group A (Open)	Group B (Laparoscopic)	Statistical Test	p-value
Surgical Site Infection	10 (8.0%)	6 (4.8%)	Chi-square	0.438
Incisional Infection	6 (4.8%)	3 (2.4%)	Chi-square	0.497
Organ-Space Infection	3 (2.4%)	3 (2.4%)	Chi-square	1.000

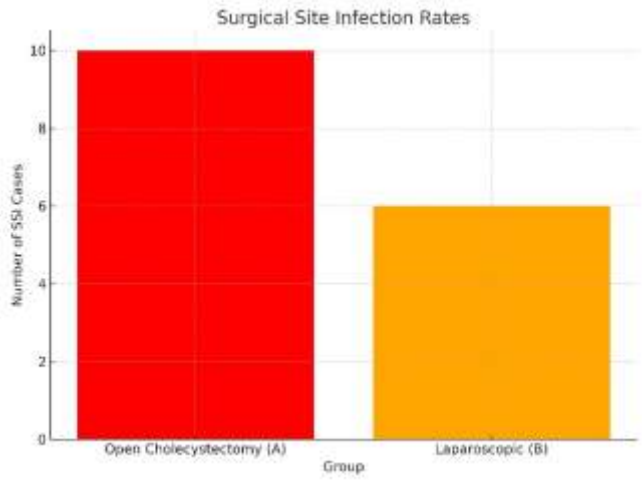

Figure 1 Surgical Site Infection Rates

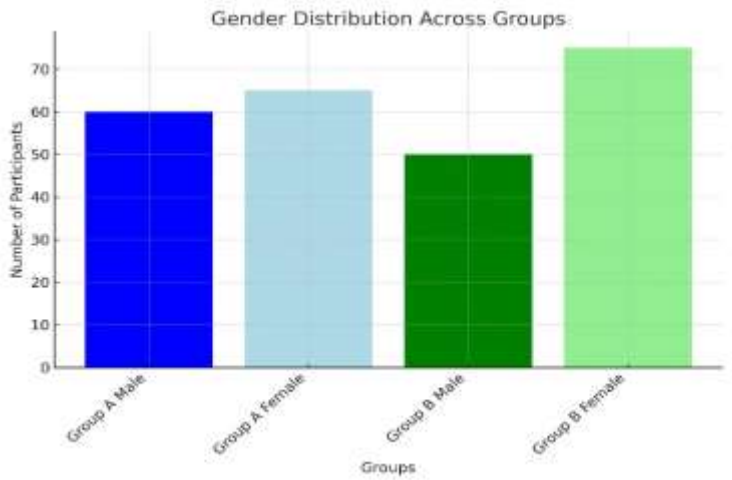

Figure 1 Gender Distribution Across Groups

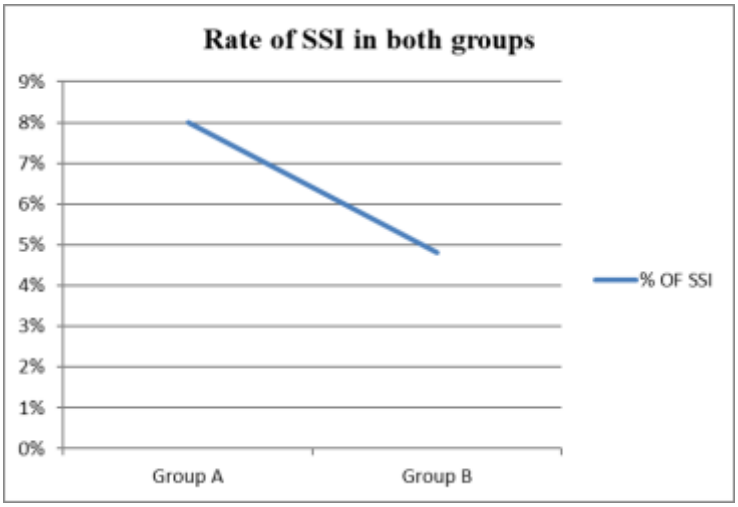

Figure 3 Rate of SSI in both Groups

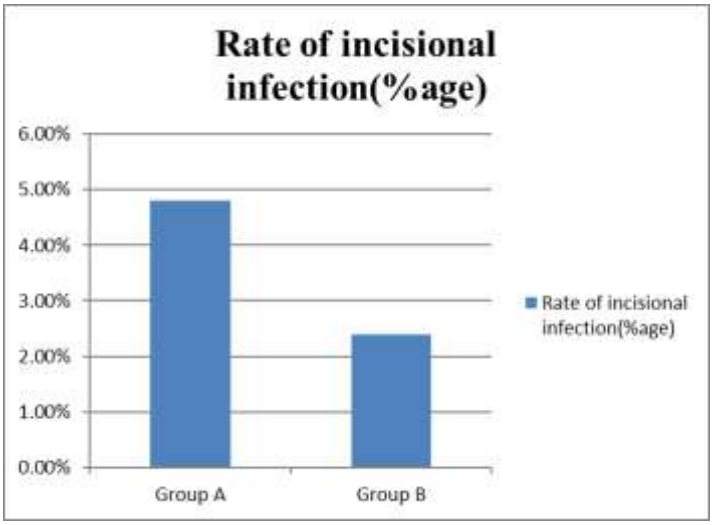

Figure 2 Rate of Incisional Infection (%age)

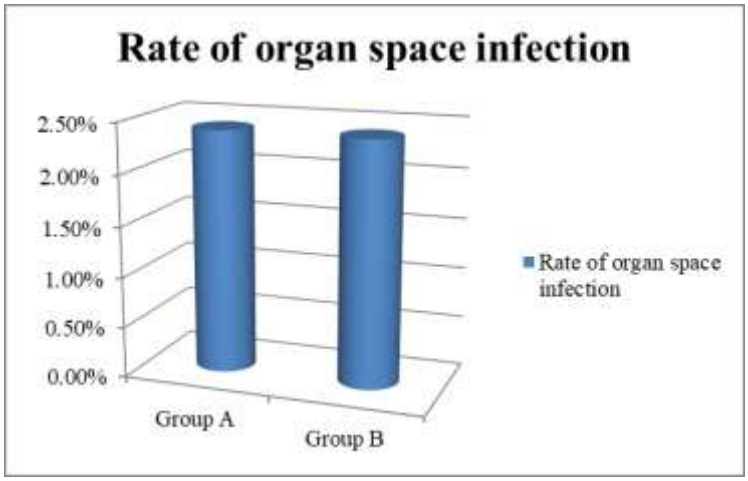

Figure 5 Rate of Organ Space Infection

DISCUSSION

The findings of the present study reinforced the widely recognized advantage of laparoscopic cholecystectomy in reducing postoperative infectious complications compared with the open approach. The lower rates of surgical site infection and incisional infection observed in the laparoscopic group aligned with the established understanding that minimally invasive procedures inherently minimize bacterial contamination risks. Smaller incisions, reduced tissue trauma, and limited exposure of intra-abdominal structures collectively contributed to the decreased likelihood of postoperative infection, a pattern well documented in previous surgical literature (12,13). These factors also enhanced early postoperative recovery, supporting the link between minimally invasive techniques and improved patient outcomes. The reduced infection burden in the laparoscopic group was further complemented by the shorter hospital stay typically associated with this technique. Early mobilization, reduced exposure to hospital flora, and faster wound healing collectively lowered the probability of nosocomial infections. Conversely, patients undergoing open cholecystectomy frequently required prolonged hospitalization, often due to greater postoperative pain, wound care needs, or the presence of underlying complexities. This extended inpatient duration contributed to a comparatively higher risk of hospital-acquired infections, reiterating the practical advantage of minimally invasive approaches in routine surgical practice (14-16). Despite the clear benefits of laparoscopic cholecystectomy, open

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surgery continued to hold clinical relevance. Certain circumstances—including acute inflammation, distorted biliary anatomy, adhesions, or limited laparoscopic resources—necessitated an open intervention. For such patients, the increased infection risk reflected the inherent demands of the procedure rather than shortcomings in operative conduct. The balanced interpretation of SSI risk therefore acknowledged that clinical context should guide the selection of surgical technique, with individualized assessment remaining central to optimal patient management (17-19).

The strengths of this study included the direct comparison of two surgical techniques within the same clinical setting, the uniform follow-up period, and the use of standardized definitions for categorizing infections. These factors enhanced internal validity and facilitated meaningful comparison. However, certain limitations required consideration. The reliance on convenience sampling introduced potential selection bias, and the absence of detailed analysis of confounding factors—such as comorbidities, BMI, smoking status, or intraoperative contamination—restricted deeper interpretation of SSI determinants. Furthermore, although inferential statistics were applied, the study remained limited by small event counts within infection subgroups, reducing statistical power. Future studies would benefit from larger multicenter cohorts, stratification by patient risk factors, and extended follow-up to capture late-presenting complications (20,21). The incorporation of microbiological profiling, operative duration analysis, and the evaluation of perioperative antibiotic protocols would provide additional clarity on modifiable factors influencing SSI rates (22). Overall, the study demonstrated that laparoscopic cholecystectomy offered clear advantages in minimizing surgical site infections and improving postoperative recovery trajectories, reaffirming its position as the preferred technique for most patients. Nonetheless, both approaches remained essential components of surgical practice, and the emphasis on comprehensive preoperative assessment, meticulous operative execution, and evidence-based preventive strategies continued to be fundamental in optimizing outcomes across surgical modalities.

CONCLUSION

The findings of this study support the preference for laparoscopic cholecystectomy as a safer and more favorable option for reducing postoperative infectious complications when compared with the open technique. The minimally invasive approach demonstrated clearer advantages in lowering the overall burden of surgical site and incisional infections, ultimately contributing to faster recovery, shorter hospital stays, and reduced healthcare costs. While open cholecystectomy remains essential in select clinical situations where anatomical complexity, severe inflammation, or limited laparoscopic resources necessitate its use, careful preoperative evaluation is critical to determine the most appropriate surgical approach. Overall, the study reinforces the importance of individualized surgical planning to optimize patient outcomes and enhance the quality of postoperative care.

AUTHOR CONTRIBUTION

Author	Contribution
Anas Jahangir*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Zulqarnain Haidar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Makhdoom Ali Raza	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Atia Ur Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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Author	Contribution
Muhammad Sulaman Fazil	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Shoaib Nadir	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Sadia Hakeem	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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