Indian Journal of Health Care, Medical & Pharmacy Practice (Vol 7, Issue 3-4, Oct-Dec 2026)
Home page of the journal: https://ijhmp.com/Home

Research Article

PORT-SITE INFECTION FOLLOWING TOPICAL AMIKACIN APPLICATION IN ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE OBSERVATIONAL STUDY

Dr. Sahidul Hoque[1], Dr. Biswajit Borah[2], Dr. Shahnaz Aktar Talukdar[3]*

[1]Postgraduate Trainee, Department of General Surgery, Assam Medical College and Hospital, Dibrugarh, Assam, India.
[2]MS, Associate Professor, Department of General Surgery, Assam Medical College and Hospital, Dibrugarh, Assam, India.
[3]PGDEMS (LIHS, Mumbai), FIP (Henry Havard).

Corresponding Author*: Dr. Shahnaz Aktar Talukdar, PGDEMS (LIHS, Mumbai), FIP (Henry Havard).
Email ID: aktarshahnaz621995@gmail.com

DOI: https://doi.org/10.59551/IJHMP/25832069/2026.7.3/4.120

How to cite this article: Hoque S, Borah B, Talukdar SA. Port-Site Infection Following Topical Amikacin Application in Elective Laparoscopic Cholecystectomy: A Prospective Observational Study. *Indian J. Health Care, Med. Pharm. Pract.* 2026;7(3-4):161-168.

COPYRIGHT@ 2026, IJHMP | This work is licensed under a Creative Commons Attribution 4.0 International Licence

Received: 11 Oct, 2026, Decision for Acceptance: 17 Nov, 2026

ABSTRACT

Background: Port-site infection remains an important complication of laparoscopic cholecystectomy. Evidence about local antibiotic application must be interpreted in relation to study design.

Objective: To describe the frequency, distribution and clinical course of port-site infection among patients receiving topical amikacin at closure after elective laparoscopic cholecystectomy.

Methods: This single-centre prospective observational study included 120 adults undergoing elective four-port laparoscopic cholecystectomy at Assam Medical College and Hospital, Dibrugarh, from September 2024 to September 2025. All received a single application of amikacin at the four port sites during closure. Clinical review was scheduled on postoperative days 3, 7, 14 and 28. Outcomes were summarized descriptively.

Results: The mean age was 41.41 ± 7.65 years and 84 patients (70.0%) were women. Fourteen patients (11.67%) developed port-site infection (95% Wilson confidence interval, 7.1–18.6%). Eight of the 14 infections (57.14%) involved the umbilical port. Eleven infections (78.57%) were reported within five postoperative days. Wound discharge was documented in 14 patients (11.67%) and bleeding in three (2.50%).

Conclusion: Port-site infection occurred in approximately one in nine patients after topical amikacin application. In the absence of an untreated or alternative-treatment comparator, these data do not demonstrate preventive efficacy. Controlled studies are required to establish whether topical amikacin reduces infection risk.

KEYWORDS: Amikacin, Laparoscopic Cholecystectomy, Port-site Infection, Surgical Site Infection, Prospective Observational Study.

Introduction

Laparoscopic cholecystectomy has become an established operative approach for symptomatic gallbladder disease. Small abdominal incisions, magnified visualization and a comparatively rapid postoperative recovery have contributed to its adoption. Nevertheless, minimally invasive access does not eliminate surgical wound complications. The trocar entry sites remain potential locations for inflammation, bleeding, wound separation and infection. The advantages of the laparoscopic approach can be diminished when a patient develops persistent drainage, requires repeated dressing, or must return for postoperative assessment[1-3].

Port-site infection is clinically relevant because it may cause pain, delayed wound healing and additional outpatient visits. The infection burden is influenced by the population under study, the procedure performed, wound surveillance and the diagnostic criteria applied. A superficial infection detected during an early scheduled review may not be comparable with a deep or delayed infection presenting weeks after surgery. Accordingly, reporting should distinguish the overall frequency of infection from its location, time of onset and clinical management[2,4,5].

A range of potential mechanisms has been described. Contamination during insertion or withdrawal of instruments, handling of the gallbladder during extraction, tissue injury, and lapses in instrument processing may contribute to wound complications. In some settings, delayed port-site infection has been associated with atypical mycobacteria. Such mechanisms cannot be inferred solely from the appearance of an infected wound; microbiological assessment and a careful review of the operative context may be necessary[2,6,7].

Patient-level factors are also important when interpreting postoperative wound outcomes. Diabetes mellitus, anaemia and other chronic conditions can coexist in surgical cohorts and may affect wound recovery. However, demonstrating an association between a comorbidity and infection requires data on infection occurrence in both exposed and unexposed subgroups. Describing the prevalence of a condition in the overall cohort is not sufficient to establish it as a risk factor in that particular study[3,8].

Antibiotic prophylaxis in laparoscopic cholecystectomy has been investigated through differing approaches, including systemic prophylaxis and topical application. Published studies vary in eligibility criteria, antibiotic regimens and comparison groups. The rationale for applying an antibiotic directly at the wound is local exposure, but a single-arm study cannot determine the incremental protection offered by the intervention. In particular, a postoperative infection proportion observed after topical application is not equivalent to a reduction relative to an untreated group[9-11].

The present study was undertaken at a tertiary-care surgical department in Assam. Its purpose was to document the postoperative port-site infection experience of patients undergoing elective laparoscopic cholecystectomy who all received topical amikacin at closure. The report emphasizes descriptive epidemiology and the clinical pattern of observed infections, while clearly separating those findings from questions of treatment efficacy that require comparative research.

Objectives

The primary objective was to estimate the proportion of patients with clinically recorded port-site infection following elective laparoscopic cholecystectomy with topical amikacin application at closure.

Secondary objectives were to describe demographic and operative characteristics; document postoperative wound findings; characterize the anatomical distribution and timing of infection; and summarize the management categories recorded in the thesis. The study was not designed to compare topical amikacin with placebo, no topical antibiotic or another prophylactic regimen.

Materials and Methods

Study design and setting

This hospital-based prospective observational study was undertaken in the Department of General Surgery, Assam Medical College and Hospital, Dibrugarh, Assam, India. The thesis specifies a one-year study period extending from September 2024 to September 2025. Patients undergoing elective laparoscopic cholecystectomy were observed under a common local antibiotic protocol. The analysis presented here is a single-cohort description, not a randomized or controlled trial.

The source thesis reports 120 enrolled participants and states that all received topical amikacin at closure. Because individual-level data, a recruitment log and a screening denominator were not supplied, the numbers assessed for eligibility and excluded before enrollment cannot be reconstructed. The flow diagram therefore begins at the enrolled cohort rather than implying an unverified recruitment pathway.

Eligibility Criteria

The thesis lists patients aged 18–68 years undergoing elective laparoscopic cholecystectomy who provided informed consent as eligible. Exclusion criteria included a known allergy to amikacin, pre-existing infection at a port site, contraindication to laparoscopic surgery, chronic kidney disease, and inability or unwillingness to provide written informed consent.

These criteria are reproduced as documented in the thesis. The underlying case-record forms were not available for an independent audit of individual eligibility, protocol deviations or missing measurements.

Preoperative Assessment

Baseline assessment included clinical history, coexisting illnesses, recent antibiotic exposure and investigations appropriate to age and anaesthetic assessment. Abdominal ultrasonography was performed to support the diagnosis of gallstone disease. Liver function tests, including bilirubin and alkaline phosphatase, were documented in the thesis as part of evaluation for possible bile duct stones. The manuscript does not introduce additional preoperative tests or thresholds that were not specified in the source material.

Operative approach and topical intervention

All participants underwent a standard four-port laparoscopic cholecystectomy. The thesis describes application of a single

dose of injectable amikacin at each of the four port sites on the operating table after completion of the operation and before primary dressing. The exact amount per port, dilution, administration depth and precise tissue plane are not consistently specified in the available text and must be confirmed from the original operative protocol before submission.

The intervention was applied to all enrolled participants; there was no separate control group. The records available in the thesis do not establish whether any concomitant systemic prophylactic antibiotics were administered uniformly, selectively or according to a departmental protocol. The manuscript therefore does not assume that topical amikacin was the sole antimicrobial exposure.

Postoperative follow-up and Wound Assessment

Participants were scheduled for outpatient assessment on postoperative days 3, 7, 14 and 28. They were also advised to seek medical review if signs of infection or wound discharge occurred between appointments. The thesis states that wound infection was assessed according to Centers for Disease Control and Prevention criteria, but does not provide an individual-level classification of every episode as superficial incisional, deep incisional or organ-space infection[12].

Clinical wound observations included discharge, bleeding, dehiscence and infection. Where infection occurred, the thesis describes wound opening, lavage and further management according to clinical need, including secondary suturing when indicated. Because the available aggregate tables do not link each management action to a specific infected patient, treatment outcomes are presented conservatively.

Outcome Definitions and Denominators

The primary outcome was the number of patients with a port-site infection divided by the total number enrolled (n = 120). For infection site and onset, the denominator was the 14 patients with recorded infection, rather than all 120 patients. These denominators are stated alongside results to avoid interpreting the proportion of infections at a given port as the absolute risk of infection at that port.

The thesis includes a discrepancy: the primary infection table and abstract report 14 infections, whereas some narrative passages describe 15. This manuscript uses the internally consistent tabulated count of 14 and identifies the discrepancy for author verification. No individual patient record has been altered to reconcile the difference.

Statistical Analysis

The thesis reports data entry in Microsoft Excel and descriptive analysis using SPSS version 20.0. Continuous variables were summarized using mean and standard deviation where provided; categorical variables were presented as counts and percentages. Because the original dataset was not supplied, no multivariable model, subgroup hypothesis test or patient-level association analysis has been generated for this manuscript.

For interpretive clarity, a Wilson score 95% confidence interval was calculated from the reported infection numerator (14) and cohort denominator (120). This interval is a derived descriptive statistic, not a value directly reported in the thesis. All other numerical findings are based on the thesis tables. A p-value has not been assigned to a single-arm infection proportion, as there is no prespecified comparator.

Ethical Considerations

The thesis reports approval from the Institutional Ethics Committee (H), Assam Medical College and Hospital, and states that written informed consent was obtained. The ethics approval identifier and date should be inserted only after verification from the original certificate. Publication of identifiable clinical images requires appropriate consent for publication and confirmation of image provenance; consent to participate in the study does not automatically establish consent for publication of photographs.

Results

Study Population and Baseline Profile

All 120 participants were described as receiving topical amikacin. The mean age was 41.41 ± 7.65 years, and 84 (70.0%) were women. The age distribution was concentrated in the 31–50-year range. Diabetes mellitus was recorded in 30 patients (25.0%), hypertension in 26 (21.7%), anaemia in 19 (15.8%) and thyroid disorders in three (2.5%). These conditions were not stated to be mutually exclusive.

Mean operative duration was 61.33 ± 8.03 minutes. Every participant was described as undergoing a four-port operation. The thesis does not provide a patient-level distribution of operative time by infection status; it is therefore not possible to estimate whether longer operations were associated with infection in this cohort.

Table 1: Demographic, clinical and operative characteristics of the study cohort (n = 120)

Characteristic	Value
Age, mean ± SD (years)	41.41 ± 7.65
18–30 years	9 (7.50%)
31–40 years	50 (41.67%)
41–50 years	44 (36.67%)
51–60 years	17 (14.17%)
Female	84 (70.00%)
Male	36 (30.00%)
Diabetes mellitus	30 (25.00%)
Hypertension	26 (21.67%)
Anemia	19 (15.83%)
Thyroid disorder	3 (2.50%)
Surgery duration, mean ± SD (minutes)	61.33 ± 8.03
Four-port procedure	120 (100%)

ISSN 2583-2069

Comorbidity categories may overlap. Percentages are calculated against the full cohort.

Table 2: Recorded postoperative wound outcomes and management categories (n = 120)

Outcome	n (%)
Port-site infection	14 (11.67)
No port-site infection	106 (88.33)
Wound discharge	14 (11.67)
Bleeding	3 (2.50)
Wound dehiscence	0 (0.00)
Port-site hernia	0 (0.00)
Management recorded as "with antibiotics"	102 (85.00)
Management recorded as "without antibiotics"	18 (15.00)

Management categories are reproduced as reported; the thesis does not clarify whether "with antibiotics" indicates prophylaxis or treatment.

Table 3: Anatomical distribution and timing of port-site infection (n = 14)

Variable	n (%)
Umbilical port	8 (57.14)
Epigastric port	3 (21.43)
Right subcostal port	2 (14.29)
Lateral port	1 (7.14)
Onset, postoperative days 1–2	6 (42.86)
Onset, postoperative days 3–5	5 (35.71)
Onset, postoperative days 6–8	3 (21.43)

Percentages are calculated among the 14 patients with infection, not among all procedures.

Primary Outcome: Infection Occurrence

Port-site infection was recorded in 14 of 120 patients (11.67%), while 106 (88.33%) had no recorded infection. The derived 95% Wilson confidence interval for the observed proportion was approximately 7.1% to 18.6%. The width of this interval reflects the sample size and the number of events; it does not quantify the effect of amikacin.

Wound discharge was recorded in 14 patients (11.67%) and bleeding in three (2.50%). No cases of wound dehiscence or port-site hernia were tabulated. The overlap between the 14 discharge events and the 14 infection events cannot be confirmed from the available aggregate data; they should not automatically be treated as identical patients.

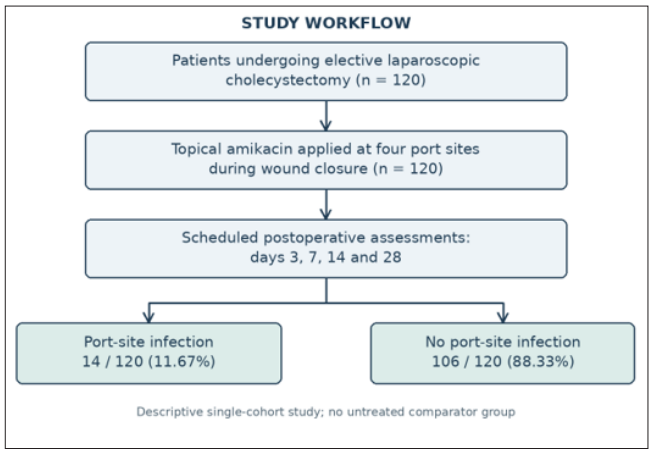

Figure 1. Descriptive flow diagram of the single-cohort study and observed postoperative outcomes

Location of infection

Among the 14 recorded infections, eight (57.14%) were at the umbilical port, three (21.43%) at the epigastric port, two (14.29%) at the right subcostal port and one (7.14%) at the lateral port. The umbilical location accounted for the largest share of recorded events. However, because the dataset was not provided at the individual port level, these counts cannot be used to compare port-specific infection risk after adjustment for specimen extraction or other procedural exposures.

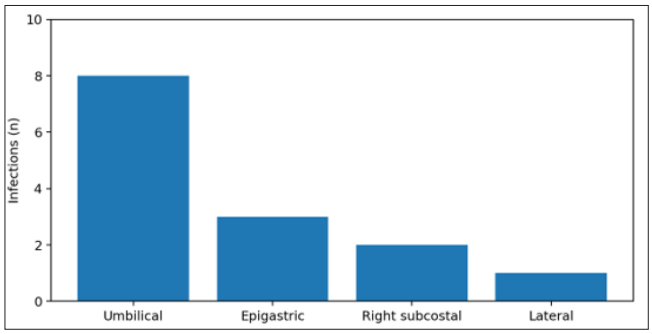

Figure 2. Distribution of the 14 infections by port location

Timing of infection

Six infections (42.86%) were first recorded on postoperative days 1–2, five (35.71%) on days 3–5 and three (21.43%) on days 6–8. Thus, 11 of 14 recorded infections (78.57%) had onset within the first five postoperative days. The surveillance schedule extended to day 28, but the onset table contains no infections first identified after day 8.

The onset intervals are those used in the thesis. The scheduled day-3, day-7, day-14 and day-28 visits do not by themselves establish the exact onset date for every event; the recorded categories may reflect patient-reported symptoms between appointments.

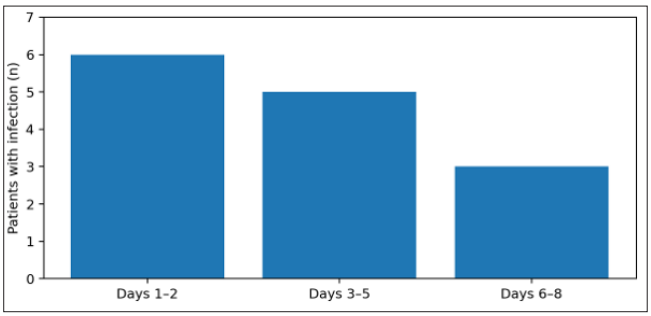

Figure 3. Time to first recorded port-site infection among the 14 affected patients

Clinical photographic documentation

The following clinical images were supplied with the manuscript materials to illustrate wound appearances and the operative setting. They are descriptive illustrations rather than a standardized photographic outcome series. No patient-level inference, microbiological diagnosis or treatment response is derived from their appearance alone. The final published selection should include only photographs for which source attribution and permission for publication have been documented.



Figure 4. Supplied clinical image showing postoperative changes at port sites



Figure 5. Supplied clinical image showing localized swelling near a postoperative port site

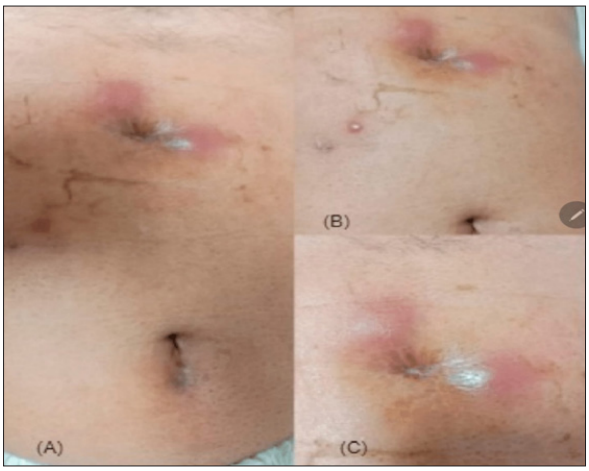

Figure 6. Supplied multi-panel clinical photograph showing postoperative port-site changes



Figure 7. Supplied intraoperative photograph illustrating local application near a port site

Discussion

Principal Findings and Interpretation

In this prospective observational cohort of 120 patients, the tabulated postoperative infection proportion was 11.67% following elective laparoscopic cholecystectomy with topical amikacin application at all four port sites. Infections were most frequently recorded at the umbilical port, and most had their first recorded onset within five days of surgery. These are the central findings supported by the available data. The observations describe outcomes under a particular institutional practice, not the causal effect of the local antibiotic.

The study contributes an institution-specific account of postoperative wound events with planned surveillance through day 28. A clear distinction between event frequency and treatment effect is essential. Even if a similar cohort without topical amikacin had a different infection proportion in another study, the difference could arise from variations in case selection, instrument processing, wound definitions, operator practice, systemic prophylaxis or follow-up completeness. The present dataset contains no concurrent comparison that could separate these explanations[2,9-11].

ISSN 2583-2069

Comparison with Published Port-site Infection Literature

Sasmal and colleagues reviewed port-site infection in laparoscopic surgery and emphasized the importance of recognizing both early postoperative infections and delayed presentations associated with less common organisms[2]. Their discussion provides a clinical framework for understanding why a seemingly small incision may still generate substantial morbidity. The present cohort mainly documents early events, with the last onset category ending at postoperative day 8; this does not exclude the possibility of later infections in other populations or with longer follow-up.

Karthik and colleagues examined laparoscopic port-site complications in a descriptive study, supporting the value of careful classification of complications rather than a single aggregate wound-outcome category[4]. Siddiqua and colleagues also reported port-site infections following laparoscopic cholecystectomy[5]. Direct numerical comparisons should be interpreted cautiously because studies differ in case mix, definitions and surveillance duration. The present manuscript therefore avoids presenting cross-study percentages as if they were results of a common controlled experiment.

The observational report by Pipal and colleagues provides another clinical comparison focused on laparoscopic cholecystectomy[13]. Differences between institutions may reflect the use of distinct instrument processing pathways, gallbladder extraction techniques, patient characteristics and postoperative monitoring. Without harmonized denominators and covariate information, such comparisons are best used to identify research questions rather than to rank institutional infection-control performance.

Anatomical Distribution and Possible Mechanisms

The umbilical port represented eight of the 14 recorded infections. This predominance is clinically noteworthy because the umbilical region can be involved in specimen retrieval and is an anatomically distinct access site. However, the thesis does not provide a patient-level record of which port was used for specimen extraction, bile or stone spillage, wound contamination or extraction-bag use. Therefore, the observed distribution cannot establish that any of those factors caused the infections.

The surgical literature recognizes the importance of port handling and local wound care. Studies of gallbladder retrieval site selection, including the systematic review by Hajibandeh and colleagues, illustrate why the umbilical and epigastric ports are relevant sites for comparative assessment[14]. Future prospective work should record extraction port, wound protection, specimen bag use, bile spillage and port-specific outcomes prospectively, allowing an analysis that distinguishes an anatomical association from a procedural mechanism.

Interpretation of Postoperative Timing

The concentration of events in the first five postoperative days has implications for follow-up design. Early contact may help identify wound discharge and local inflammatory changes promptly, particularly when patients have been discharged before the onset of symptoms. The thesis scheduled reviews at days 3, 7, 14 and 28 and encouraged additional consultation when symptoms arose. These features are useful for routine postoperative surveillance.

The absence of reported onset after day 8 should not be interpreted as evidence that later infection cannot occur. A study designed to assess delayed or atypical infection would require explicit documentation of late presentations, microbiological sampling and potentially a longer surveillance window. Reports of nontuberculous mycobacterial outbreaks after laparoscopic procedures underline the need to consider different mechanisms in persistent or unusual wound presentations[6,7].

Role and Limits of Topical Antibiotic Application

Topical amikacin was administered at closure to every enrolled participant. Amikacin is an aminoglycoside antibacterial agent, but the study did not measure local tissue concentrations, bacterial susceptibility or systemic absorption. It also did not include a comparator regimen. Consequently, neither a pharmacological dose-response relationship nor an infection-prevention effect can be estimated from these results.

Sharma and colleagues investigated topical antibiotics in elective day-care laparoscopic cholecystectomy[9], while Matsui and colleagues conducted a randomized trial of antibiotic prophylaxis in laparoscopic cholecystectomy[10]. A meta-analysis by Yan and colleagues also considered prophylactic antibiotics and postoperative infection[11]. These publications concern related questions, but their designs and interventions should not be treated as interchangeable. In particular, evidence about systemic prophylaxis cannot automatically be extrapolated to local amikacin application at a trocar wound.

An appropriately designed future trial would compare a clearly specified topical regimen against standard care, with consistent systemic prophylaxis, standardized wound surveillance and prespecified infection definitions. Such a study should record exact dose, route, wound depth, microbiology and potential adverse reactions. Until comparative data are available, the present findings are descriptive rather than confirmatory evidence of benefit.

Patient Characteristics and Potential Confounding

Women comprised 70% of the cohort, reflecting the composition of the operated population. The thesis does

not present infection counts stratified by sex in the primary results tables. Therefore, it is not valid to conclude that women had a higher infection risk merely because more women underwent surgery. The same denominator principle applies to age groups and comorbidities.

Diabetes mellitus, hypertension, anaemia and thyroid disorders were recorded at baseline. These factors may be clinically relevant when planning future risk-factor research, but the present aggregate data do not show how many infected patients had each condition. Statements that diabetes or anaemia increased infection risk in this cohort would require a two-by-two comparison or patient-level regression analysis. Surgical-site infection literature identifies multiple potential patient and procedural contributors, reinforcing the importance of measuring these variables rather than inferring their effects[3,8,12].

Postoperative Management and Safety Reporting

The thesis records 102 patients under a management category labeled "with antibiotics" and 18 under "without antibiotics". The category is ambiguous: it is not clear whether the entries refer to routine systemic perioperative prophylaxis, postoperative therapy, or another practice. Because 102 patients exceeds the number with recorded port-site infection, the figure cannot reasonably be interpreted as the number of infected patients treated with antibiotics without further clarification.

Wound discharge, bleeding and absence of tabulated dehiscence or hernia are presented as observed postoperative findings. They should not be labeled adverse drug reactions to amikacin, because causality was not assessed. Similarly, no systematic renal or auditory safety assessment attributable to local amikacin was provided in the aggregate results. The source supports description of the wound findings, not a claim of proven drug safety.

Methodological Strengths

The study has several descriptive strengths: a defined clinical setting, a specified one-year recruitment period, a consistent four-port procedure, uniform documented topical application and planned postoperative review. The thesis includes an explicit numerator and denominator for the primary outcome and records both anatomical site and timing of infection. These details permit a coherent clinical description and facilitate transparent reporting.

The structured presentation in this manuscript also distinguishes raw source results from a derived confidence interval. This approach helps readers understand which findings are observed and which are calculated from published counts. The use of figures is intended to clarify the data rather than to introduce new unverified results.

Limitations

The principal limitation is the absence of a control group. As a result, causal claims about infection prevention by topical amikacin cannot be supported. The study was performed at a single institution, limiting generalizability. No raw dataset was supplied for independent checking, and no patient-level associations between infection and age, sex, comorbidity, operative duration or management were available.

The thesis contains an inconsistency between the primary infection table (14 infections) and parts of its narrative (15 infections). The present manuscript uses the tabulated value, but the final count requires author confirmation. The exact amikacin dose and route, systemic antibiotic exposure, microbiological culture results, and some details of case ascertainment were not sufficiently documented for full replication.

The photographic material requires verification of consent for publication and image provenance. The manuscript also lacks a screening log, detailed missing-data assessment, and an infection-specific severity classification. These limitations should remain visible to peer reviewers rather than be concealed by unsupported additions.

Implications for Practice and Future Research

The observed events support continued attention to standardized port-site care, instrument reprocessing, careful specimen extraction and accessible postoperative wound review. These are general infection-control priorities rather than interventions whose effects were tested in this dataset[2,3,12]. The relatively high proportion of infections located at the umbilical port suggests a useful focus for future prospective documentation, not proof of a site-specific causal pathway.

A multicentre comparative study could evaluate whether topical amikacin adds benefit to established perioperative care. It should use a prospectively registered protocol, clear allocation strategy, standardized antibiotic exposure, predefined follow-up and blinded outcome assessment where feasible. Recording wound culture results and patient-level predictors would allow estimation of absolute risk differences and clinically meaningful subgroup effects.

Conclusion

In this prospective single-centre cohort of 120 patients undergoing elective laparoscopic cholecystectomy with topical amikacin application at closure, 14 patients (11.67%) had a recorded port-site infection. The umbilical port was the most frequent location, and most infections were recorded within five postoperative days. The findings describe the observed postoperative infection profile under the study protocol.

Because no comparator group was included, the data do not establish that topical amikacin reduced infection risk. Clarification of the conflicting infection counts and missing intervention details, followed by appropriately controlled

ISSN 2583-2069

research, is necessary before drawing conclusions about prophylactic efficacy.

Declarations

Ethics Approval and Consent to Participate: The source thesis reports institutional ethics approval and written informed consent. The approval identifier and date must be confirmed from the certificate before submission.

Consent for Publication: Written consent specifically permitting publication of clinical photographs must be verified for each identifiable patient image.

Funding: Not specified in the thesis; to be confirmed by the authors.

Conflicts of Interest: Not specified in the thesis; to be confirmed by the authors.

Data Availability: Individual participant data were not supplied for preparation of this manuscript. Any data-sharing statement must be approved by the responsible investigators and comply with institutional requirements.

Author Contributions: Final author eligibility, order and contributions require confirmation by all listed authors.

Conflicts of Interest

None

References

1. Buia A, Stockhausen F, Hanisch E. Laparoscopic surgery: a qualified systematic review. World J Methodol. 2015;5(4):238-254.
2. Sasmal PK, Mishra TS, Rath S, Meher S. Port site infection in laparoscopic surgery: A review. World J Gastrointest Surg. 2015;7(12):446-455.
3. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008;70(Suppl 2):3-10.
4. Karthik S, Augustine A, Shibumon M, Pai M. Analysis of laparoscopic port site complications: A descriptive study. J Minimal Access Surg. 2013;9(2):59. doi:10.4103/0972-9941.110964
5. Siddiqua SS, Khan MAI, Khan MAU, Sayeed S. Port Site Infections Following Laparoscopic Cholecystectomy. Bangladesh J Med. 2018 Aug 18;29(2):51–8. doi:10.3329/bjmed.v29i2.37938
6. Vijayaraghavan R, Chandrashekhar R, Sujatha Y, Belagavi CS. Hospital outbreak of atypical mycobacterial infection of port sites after laparoscopic surgery. J Hosp Infect. 2006;62(3):344–7.
7. Phillips MS, von Reyn CF. Nosocomial infections due to nontuberculous mycobacteria. Clin Infect Dis. 2001;33(8):1363–74.
8. Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. Indian J Med Microbiol. 2005 Oct;23(4):249–52. PubMed PMID: 16327121.
9. Sharma N, Kaman L, Khare S, Dahiya D, Gupta A, Thakur UK, et al. Topical antibiotics in the prevention of port-site infection after elective day care laparoscopic cholecystectomy. Indian J Pharmacol. 2024 Jan 1;56(1):16–9. doi:10.4103/ijp.ijp_882_20 PubMed PMID: 38454584; PubMed Central PMCID: PMC11001178.
10. Matsui Y, Satoi S, Kaibori M, Toyokawa H, Yanagimoto H, Matsui K, et al. Antibiotic Prophylaxis in Laparoscopic Cholecystectomy: A Randomized Controlled Trial. Gluud LL, editor. PLoS ONE. 2014 Sep 5;9(9):e106702. doi:10.1371/journal.pone.0106702
11. Yan RC, Shen SQ, Chen ZB, Lin FS, Riley J. The Role of Prophylactic Antibiotics in Laparoscopic Cholecystectomy in Preventing Postoperative Infection: A Meta-Analysis. J Laparoendosc Adv Surg Tech. 2011 May;21(4):301–6. doi:10.1089/lap.2010.0436
12. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999 Apr;27(2):97–132; quiz 133–4; discussion 96. PubMed PMID: 10196487.
13. Pipal DK, Prakash R, Kalwan P, Sudha S, Pipal VR, Yadav S. Port Site Infection in Laparoscopic Cholecystectomy: A Prospective Observational Study at a Tertiary Care Hospital in India. Ann Afr Med. 2026 Jan;25(1):151–7. doi:10.4103/aam.aam_33_25
14. Hajibandeh S, Hajibandeh S, Clark MC, Barratt OA, Taktak S, Subar D, et al. Retrieval of Gallbladder Via Umbilical Versus Epigastric Port Site During Laparoscopic Cholecystectomy: A Systematic Review and Meta-Analysis. Surg Laparosc Endosc Percutan Tech. 2019 Oct;29(5):321–7. doi:10.1097/SLE.0000000000000662
15. Strasberg SM, Brunt LM. The critical view of safety in laparoscopic cholecystectomy. J Am Coll Surg. 2010;211(1):132-138.
16. Gaynes RP, Culver DH, Horan TC, Edwards JR, Richards C, Tolson JS, et al. Surgical Site Infection (SSI) Rates in the United States, 1992–1998: The National Nosocomial Infections Surveillance System Basic SSI Risk Index. Clin Infect Dis. 2001 Sep;33(s2):S69–77. doi:10.1086/321860