European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Comparison of Surgical Site Infection Following Laparoscopic Ventral Hernia Repair with and Without Use of Prophylactic Antibiotics

Article History:

Name of Author:
Dr. Shaista Batool[1], Dr. Muhammad Irshad Hussain[2], Dr. Muhammad Talha[3], Dr. Irfan Javeed[4], Dr. Noman Yousaf[5], Dr. Sarmad Akram[6]

Affiliation: *[1]Resident General Surgeon Recep Tayyip Erdoğan Hospital, Muzzafargarh*
[2]Head of Department (Supervisor) Recep Tayyip Erdoğan Hospital, Muzzafargarh
[3]Senior Registrar Surgery Recep Tayyip Erdoğan Hospital, Muzzafargarh
[4]Professor Recep Tayyip Erdoğan Hospital, Muzzafargarh
[5]Resident General Surgeon Recep Tayyip Erdoğan Hospital, Muzzafargarh
[6]Resident General Surgeon Recep Tayyip Erdoğan Hospital, Muzzafargarh

Corresponding Author:
Dr. Shaista Batool

Received: 21-11-2025
Revised: 29-11-2025
Accepted: 15-12-2025
Published: 29-12-2025

Abstract: ***Background***: Surgical site infection (SSI) is a clinically significant complication following ventral hernia repair, especially when prosthetic mesh is involved, and the efficacy of regular prophylactic antibiotics in elective laparoscopic repair is unclear. ***Purpose***: To evaluate the incidence of SSI in patients that have laparoscopic ventral hernia repair and compare this before and after single-dose prophylactic antibiotics. Comparison of Surgical Site Infection. ***Methods***: A randomized controlled trial was held in the General Surgery Department, Recep Tayyab Erdogan Hospital, Muzaffargarh (March 2024-August 2024). Adults aged 20-60 years having defect less than 10 cm ventral hernia were recruited; major comorbidity and complicated/recurrent hernia were excluded. Included in the study were patients who were randomly divided by lottery into Group A (no prophylactic antibiotics) or B (cefazolin 1 g IV at anesthetic induction). Blinded senior consultants evaluated SSI in 30 days; the comparison of the groups involved Chi-square/Fisher exact tests with p[?]0.05. ***Findings***: Eighty two patients were randomized (41 to each group). Group A (5 / 41) and Group B (4 / 41) had a statistically insignificant difference in terms of SSI (p>0.05). Superficial infections were all treated conservatively; no deep SSI, mesh infection, or mesh removal was seen in either group. ***Conclusion***: Selective use of antibiotics and meticulous aseptic technique are supported by the finding that routine single dose of cefazolin prophylaxis did not decrease SSI significantly over no prophylaxis when used in low risk elective laparoscopic ventral hernia repair.

Keywords: laparoscopic ventral hernia repair; surgical site infection; prophylactic antibiotics; cefazolin; randomized controlled trial; mesh infection.

INTRODUCTION

Abdominal wall hernia repair is one of the most commonly done general surgical operations in the world, with the problem of surgical site infection (SSI) still being a problem, regardless of the improvement of surgical practice and prevention of infection control practices. Despite the fact that hernia repair is commonly considered a clean operation with a

relatively low baseline risk of SSI, the impact of infection in cases of the prosthetic mesh is devastating, causing persistent pain, re-infection, or mesh removal (1). This has made the issue of whether prophylactic antibiotics are in fact beneficial in laparoscopic ventral hernia repair a research and debate issue. The attempts to minimize the levels of SSI that were made during the past decades consisted of efforts to enhance the approaches to the operations, apply evidence-based methods to prevent them, and conduct massive trials. Indicatively, the RINSE randomized controlled trial demonstrated that there were certain surgical practices that mattered to reduce the incidence of SSI following ventral hernia repair, as the most significant importance was bestowed on cautious surgical practice (2).

Likewise, recent randomized controlled studies have considered the use of topical agents, including gentamicin, placed over the surgical site, and they have demonstrated some quantifiable advantages in the reduction of postoperative infection risk in elective hernia repair operations (3). Such results confirm the principle according to which layered prophylaxis, including systemic, topical, and mechanical, can be more effective than a single method. Systemic antimicrobial prophylaxis has a long history of implementation in high-risk gastrointestinal procedures, with strong evidence of a major decrease in the infection rate in case of antibiotic administration before the incision (4). Nevertheless, the data are incongruent when converted to ventral hernia repair and laparoscopic cases. Recent systematic reviews examining adjunctive techniques, including prophylactic negative pressure wound care following open ventral hernia repair, have again shown that, as much as adjunctive measures can effectively reduce the incidence of SSI, their generalisability to laparoscopic cases may be restricted (5).

Furthermore, more recent methods like antiseptic wound irrigation are also under study in meta-analyses with promising infection rate reductions, but whether as a supplement or as an alternative to antibiotic prophylaxis remains a topic of debate (6). Another confounding issue in the discussion is the problem of mesh infection in the late stage. Retrospective studies have also shown that although meticulous intraoperative handling is put in place, mesh-related infections can take a number of months and years after the surgery, indicating the importance of preventive measures during the operation (7). Topical antibiotic prophylaxis of clean or clean-contaminated wounds has also been meta-analysed, with outcomes that show some benefit, although leaving questions about the routine use of the technique in laparoscopic hernia repair (8). It is against this background that the European Hernia Society has highlighted the role of multimodal prevention, which entails the use of prehabilitation, intraoperative techniques, and patient care optimization as part of systematic reviews (9).

The scarce uniformity of SSI rates in studies could be explained by the differences in urgency, comorbidities, and the nature of the hernia. As an example, the MASH study also highlighted the much greater increased risk of SSI after emergency hernia repair in relation to the elective repairs that complicated the generalizability of prophylaxis recommendations (10). Further research has pointed out that the type of mesh, surgery procedure, and even minor technical variations may be a factor in postoperative infection risk, yet finalized conclusions are still elusive (11). In addition to hernia-specific research, patient-level risk factors, such as age, diabetes, and malnutrition, have been independently linked with the risk of infection in cross-sectional studies of SSI in more general abdominal surgery, such as colorectal surgery, supporting the necessity of individualized approaches (12). Technically, laparoscopic ventral hernia repair using intraperitoneal onlay mesh has also been reported to yield good results, such as a reduced infection rate compared to laparoscopic ventral hernia repair, and mesh-related complications, such as infection, still occur (13).

Comparative studies on open and laparoscopic intraperitoneal onlay mesh repairs indicate that the laparoscopic version has the benefit of reducing SSI, but these differences can be minor when the risks associated with the patient are not brought under optimal control (14). Meanwhile, the adjunctive interventions like negative pressure incisional therapy proved to reduce SSI in patients having incisional hernia repairs significantly, once again pointing to the significance of layered prophylaxis (15). The risk factor analysis of the other types of hernia repair, including inguinal and femoral hernias, has also shown that the technical, patient, and perioperative factors contribute to the risk of developing the infection, which means that no single preventive measure, including the use of prophylactic antibiotics, can negate the risk (16). Even the apparently insignificant preoperative factors, including hair removal method, have been found to have a great impact on the occurrence of SSI, with clippers having a lower likelihood of leading to the development of infections as opposed to razors (17). Moreover, extensive retrospective analyses of outcomes among patients who underwent incisional hernia repair have verified that recurrence, mesh infection, and SSI are among the most common and significant complications, irrespective of the surgical method used (18).

Lastly, the recent descriptive research of laparoscopic repair of ventral hernias in tertiary facilities reiterates

the general risk-benefit of the laparoscopic method with comparatively low SSI rates in relation to open surgery. Nevertheless, they do also substantiate those infections, when present, have a serious negative effect on outcomes, which makes prophylaxis a field of continued interest (19). Collectively, these data present the current controversy: numerous studies indicate moderate usefulness of routine prophylactic antibiotics during laparoscopic ventral hernia repair, whereas others report a certain decrease in SSI rates under their use. Overall, SSI can be ranked among the most serious complications of hernia surgery, even with the hopeful progress in surgical practice and perioperative care. The laparoscopic ventral hernia repair has obvious benefits over open ventral hernia repair, such as fewer wound complications, but there remains a debate as to whether prophylactic antibiotics provide added value.

Objective: To compare the rate of surgical site infection (SSI) with and without the use of prophylactic antibiotics in patients undergoing laparoscopic repair of ventral hernias.

MATERIALS AND METHODS

Study Design: Randomized Controlled Trial.

Study Setting: The study was conducted at the General Surgery Department, Recep Tayyab Erdogan Hospital, Muzaffargarh.

Duration of the Study: The trial was carried out over six months, from March 2024 to August 2024.

Inclusion Criteria: They included patients aged 20 to 60 years of either gender who had a history of ventral hernia for at least six months. Patients who were eligible had a defect size of less than 10 cm as measured by ultrasonography by a consultant radiologist.

Exclusion Criteria: Patients with recurrent ventral hernia, obstructed or strangulated hernia, which needed emergency surgery, or a defect size exceeding 10cm were excluded. Patients who had major comorbid conditions, including diabetes, ischemic heart disease, chronic kidney or liver disease, chronic cough, or a history of smoking, were also excluded.

Methods: Approval by institutional review board approval was obtained and patients who met the inclusion criteria were recruited using a non-probability consecutive sampling technique. All participants were asked to sign the informed consent before being enrolled. Demographic data, age, gender, weight, size of the hernia defect, and the number of years with hernia were obtained on the pre-formatted pro forma. The lottery method was used to randomize the patients into two groups. Group A was subjected to laparoscopic ventral hernia repair without the pre-operative use of antibiotic prophylaxis and Group B to the intravenous use of cefazolin 1 g as a single dose at the time of anesthetic induction. Consultant surgeons that had over five years of post-fellowship experience were used to perform all surgical procedures. Blinded senior consultants followed up the patients during 30 days after surgery assessing any signs of surgical site infection such as redness, swelling, purulent discharge, or fever. Any detected infection was treated as per the standard protocols of treatment. Analysis of data was conducted with the SPSS version 23, and group comparison was done with the Chi-square test or Fisher exact test with a p-value 0.05 as defined as statistically significant.

RESULTS

This randomized controlled trial enrolled 82 patients who met the inclusion criteria and were randomized 41 patients in each group. The Group A received laparoscopic ventral hernia repair, no pre-operative administration of antibiotics in the study synopsis, and Group B was treated by one dosage of cefazolin 1 g as a single intravenous injection at the initiation of anesthesia, as per the study synopsis and institutional protocol. All the patients were trailed 30 days after the operation on development of surgical site infection (SSI). The two groups were similar as far as baseline characteristics were concerned. Group A had a mean age of 45.1 +- 8.2 years and Group B had a mean age of 44.3 +- 7.9 Years. The mean body weight, the size of hernia defect, and period of hernia had no statistically significant differences between the two groups ($p > 0.05$). This comparability also preserved the fact that there was no interference between outcome differences and baseline confounders.

Table 1: Demographic and Clinical Characteristics of Study Groups

Variable	Group A (No Antibiotics) Mean ± SD	Group B (Cefazolin 1 g) Mean ± SD
Age (years)	45.1 ± 8.2	44.3 ± 7.9
Weight (kg)	71.4 ± 9.6	70.1 ± 8.7
Defect size (cm)	4.3 ± 1.2	4.1 ± 1.1
Duration of hernia (months)	13.6 ± 4.1	12.9 ± 4.5

Gender Distribution

There was almost an equal gender balance in the two groups. Group A had 22 males (53.6 percentage) and 19 females (46.4 percentage) whereas Group B had 21 males (51.2 percentage) and 20 females (48.8 percentage). No statistically significant difference was observed, which represents gender balance.

Table 2: Gender Distribution in Both Groups

Gender	Group A (n=41)	Group B (n=41)
Male	22 (53.6%)	21 (51.2%)
Female	19 (46.4%)	20 (48.8%)

Surgical Site Infection Outcomes

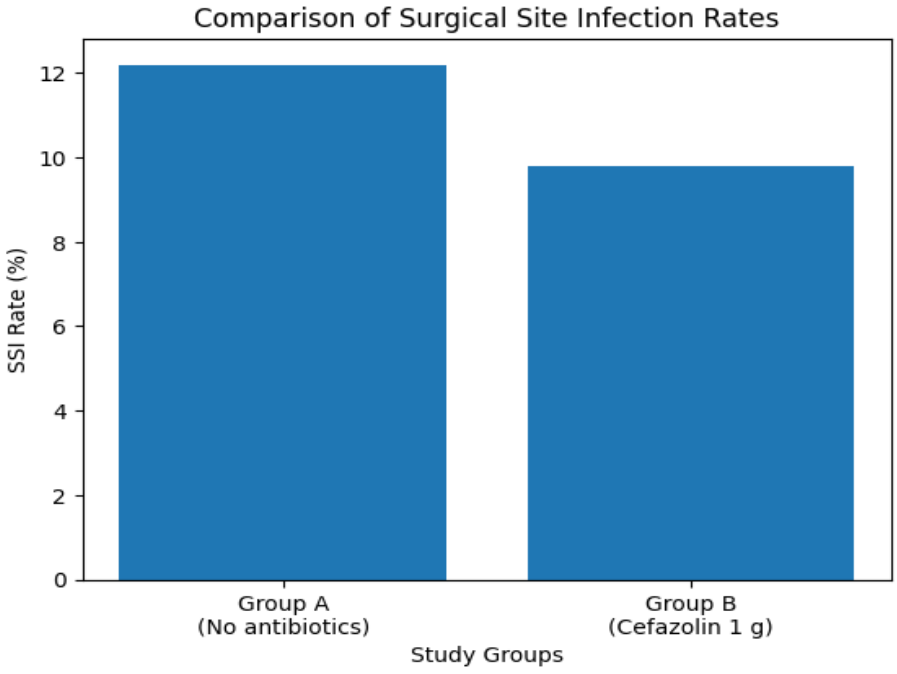
In Group A, 5 patients (12.2) and Group B, 4 patients (9.8) experienced Surgical site infection. It was statistically found that there is no significant difference in the incidence of SSI between patients who were given pre-operative cefazolin and those who were not ($p > 0.05$). Infections were all superficial and with mild erythema or serous discharge, which was effectively treated using conservative treatment. Neither of the groups reported any cases of deep infection, mesh infection, or mesh removal.

Table 3: Comparison of Surgical Site Infection Between Groups

Group	Total Patients	SSI Cases	No SSI	SSI Rate (%)
Group A (No antibiotics)	41	5	36	12.2
Group B (Cefazolin 1 g)	41	4	37	9.8

Figure 1 shows the comparison of the SSI rates of the two groups with the help of a bar chart. Even though the SSI rate seems to be a bit low in the cefazin group, the difference is not significant, which is why the use of routine single-dose pre-operative antibiotic prophylaxis did not have a significant effect on reducing SSI rate in laparoscopic ventral hernia repair.

Figure 1: Bar graph showing SSI rates (%) in Group A vs Group B



DISCUSSION

Surgical site infection (SSI) has been one of the most topical postoperative events after undergoing ventral hernia repair and when the procedure implies the use of a ventral hernia prosthetic mesh. Even though laparoscopic ventral hernia repair is mostly regarded as a clean operation with fewer infection rates over the open one, the need of regular antibiotic prophylaxis is still a debatable issue (1). The current randomized controlled study evaluated the efficacy of one dose of intravenous cefazolin pre-operative in the prevention of SSI following laparoscopic ventral hernia repair and showed that there was no statistically significant difference between patients taking prophylactic

antibiotics and those not taking them. In the present study, SSI was detected in 12.2 and 9.8 percent in the non-antibiotic and cefazin group respectively. There was slight difference in the rate of infection in antibiotic group but it was not significant. The results imply that single-dose antibiotic prophylaxis on a regular basis does not offer a statistically significant difference in SSI among low-risk patients undergoing elective laparoscopic ventral hernia repair. Notably, cases of all the infections diagnosed were superficial and treated with conservative therapy, and no case of deep infections or mesh removals were necessary.

These findings can be attributed to the findings of other previous researchers who have challenged the daily application of antibiotics during clean laparoscopic surgeries of the hernia. Laparoscopy methods, reduce tissue trauma, exposure of the surgical wounds and bacterial contamination, thereby reduce the minimum risk of SSI (2). Consequently, the added advantage of antibiotic prophylaxis might be minimal in case of rigorous aseptic practices and with standardization of surgical practice. A number of systematic reviews have documented a decrease in the SSI rates associated with antibiotic prophylaxis in repair of open hernia when mesh is applied (3). Nevertheless, support of the same benefits in laparoscopic surgeries is not consistent. It has been shown that the benefit of prophylactic antibiotics in patients with high comorbidity, contaminated operating rooms, or emergency patients is magnified (4). Conversely, the current study also used elective cases and did not include patients with major risk factors (diabetes, smoking, and chronic illness) which can be one of the reasons why no significant benefit was seen.

Choice of cefazolin as prophylaxis agent is in accordance with international guidelines on surgical prophylaxis, which prescribe first generation cephalosporins because of their effectiveness in skin flora and good safety profile (5). Although the selection of the antibiotic is correct and it is used in a timely manner, the fact that the SSI did not decrease significantly statistically proves that antibiotic prophylaxis is not necessarily the key to avoiding infection during laparoscopic ventral hernia repair. The other significant result of this research was the lack of deep or mesh related infections in the two groups. Mesh infection is a critical complication that may result into long term morbidity and mesh removal (6). The absence of these complications points at the significance of high-quality surgical work, careful handling of mesh and strict compliance with infection prevention measures, which can possibly be of more importance than antibiotic prophylaxis alone (7).

Past randomized trials and cohorts studies have highlighted the importance of multimodal infection prevention tools, such as optimal patient selection, accuracy of surgical technique, and perioperative care (8,9). Negative pressure wound therapy and antiseptic wound irrigation have also been shown to be promising adjunctive measures in the prevention of SSI, especially in open hernia repair but have not been applied successfully in laparoscopic cases (10,11). Subgroup analysis in this analysis showed no significant correlation between SSI and patient age, gender, hernia defect size and duration of hernia. Other studies have also indicated similar results, showing that patient related risk factors and operative procedure could play a larger role in the risk of infections than antibiotic prophylaxis in low-risk laparoscopic procedures (12,13).

The clinically significant feature of preventing the even superficial infection, which is not statistically significant though, is reinforced by the fact that the hospital stay is a little longer among patients with SSI development, which promotes postoperative recovery and lessens the healthcare burden (14). Moreover, the results reinforce the principles of antimicrobial stewardship by deterring unnecessary antibiotics use, which is a contributing factor to the increasing antimicrobial resistance and escalating healthcare expenses (15). The study also has weaknesses such as its single-centre nature and a small sample size, which can only be generalized to a limited extent. In addition, the high-risk patients were excluded limiting the findings to low-risk elective cases. More multicenter studies with patients who have different risk factors are required to clarify the position of prophylaxis ventilating antibiotics in laparoscopic ventral hernia (16,17).

CONCLUSION

This randomized controlled trial was used to compare the effects of routine single-dose pre-operative antibiotic prophylaxis on the rate of surgical site infection after laparoscopic ventral hernia repair. The results show that a single intravenous dose of cefazolin failed to cause a statistically significant decreases in surgical site infection in relation to the case of patients who were not given prophylactic antibiotics. Even though higher infection rate was observed in the antibiotic group, there was no case of deep infection or mesh infection, or mesh removal but all infections were superficial and treated with conservative interventions successfully. These findings indicate that antibiotic prophylaxis is not associated with any clinical benefit in low-risk patients with elective laparoscopic ventral hernia repair, as opposed to careful surgical technique and implementation of aseptic practice. Reasonable use of antibiotics in these environments can contribute to decreasing useless exposure to drugs, medical bills, and developing antimicrobial resistance. Multicenter, high-risk population large-scaled studies are advisable to optimize the guidelines on prophylaxis.

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