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

Comparison of Surgical Site Infection Following Gallbladder Extraction from Umbilical versus Epigastric Port in Laparoscopic Cholecystectomy, A Prospective Comparative Study

Article History:

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Received: 19-11-2025
Revised: 26-11-2025
Accepted: 16-12-2025
Published: 28-12-2025

Abstract: Background: Objective: To compare the frequency of surgical site infection (SSI) following gallbladder extraction through the umbilical versus epigastric port in laparoscopic cholecystectomy. **Study Design:** Prospective comparative study.**Place and Duration of Study:** Department of Surgery, CMH Lahore, from May 2025 to October 2025 (over six months).**Methodology:** A total of 656 patients were randomized into two groups. In Group-A, the gallbladder was retrieved through the umbilical port, while in Group-B, extraction was performed via the epigastric port. Standard operative technique and antibiotic prophylaxis were used. SSI was defined according to CDC criteria and assessed up to 30 days postoperatively. Data were analyzed using SPSS version 20; Student's t-test and Chi-square test were applied, with $p \leq 0.05$ considered significant.**Results:** The mean age was 41.2 ± 10.8 years in Group-A and 40.7 ± 11.1 years in Group-B (p=0.58). Both groups were comparable regarding gender, BMI, operative time, and hospital stay (p>0.05). Overall, SSI occurred in 23 patients (3.5%). The frequency was significantly higher in the umbilical group (18/328; 5.5%) compared to the epigastric group (5/328; 1.5%) (p=0.01). The relative risk of SSI with umbilical extraction was 3.6 (95% CI: 1.35–9.59).**Conclusion:** Gallbladder retrieval through the umbilical port was associated with a significantly higher rate of surgical site infection compared to the epigastric port.

Keywords: Laparoscopic cholecystectomy, Surgical site infection, Umbilical port, Epigastric port.

How to Cite: Kiran, A., Awan, M. Y., Rafeeq Alam, K., Zulfiqar Ali, M., Malik, J., & Joya, R. S. (n.d.). Comparison of surgical site infection following gallbladder extraction from umbilical versus epigastric port in laparoscopic cholecystectomy: A prospective comparative study. *European Journal of Clinical Pharmacy*. 2025. 7(1) 9789-9794

INTRODUCTION

The gold standard for treating gallstone disease symptoms is laparoscopic cholecystectomy because of its quick recovery, safety and effectiveness.1 Despite being minimally invasive, surgical site infection (SSI) is one of the most common postoperative consequences, causing patient discomfort, delayed wound healing, longer hospital stays and higher healthcare expenditures.2 The gallbladder is typically removed via the umbilical or epigastric port during a laparoscopic cholecystectomy.3 The umbilical port is usually used because of its central position and superior cosmetic results. However, it is more susceptible to bacterial contamination through skin creases and periumbilical colonization.4 Alternatively, the epigastric port facilitates specimen extraction and may lower SSI rates, but concerns about greater postoperative pain and scarring have limited its use.5

Previous research has yielded mixed results regarding the impact of extraction site on SSI incidence. For example, Jain et al. found that 20% of patients in the epigastric-port group developed surgical site infection by postoperative day 10, whereas none in the umbilical-port group did6, whereas other trials and meta-analyses found no significant difference between the two techniques.7

In Pakistan, there is limited local data addressing this issue, and practice remains heterogeneous among surgeons.8 The present study was therefore designed to compare the frequency of surgical site infection following gallbladder extraction through the umbilical versus the epigastric port in patients undergoing elective laparoscopic cholecystectomy. Findings from this study aim to provide evidence-based guidance for standardizing the retrieval technique and minimizing postoperative complications.

Methodology:

This comparative study was conducted at the Department of Surgery, CMH Lahore, over six months (May 2025 to October 2025) after approval from the Institutional Ethical Review Committee.

Sample size was calculated for comparison of two proportions (two-sided $\alpha = 0.05$, power = 80%). Based on reported port-site infection rates of 5.7% (umbilical port extraction) and 1.6% (epigastric port extraction) from Shaikh et al., the sample size of 328 patients per group (total n = 656) was calculated.[9]
Inclusion criteria: Patients aged 18–65 years undergoing elective laparoscopic cholecystectomy for symptomatic gallstone disease.

Exclusion criteria: Acute cholecystitis, empyema or perforated gall bladder, previous upper abdominal surgery, immunocompromised status, conversion to open cholecystectomy, and refusal to participate.

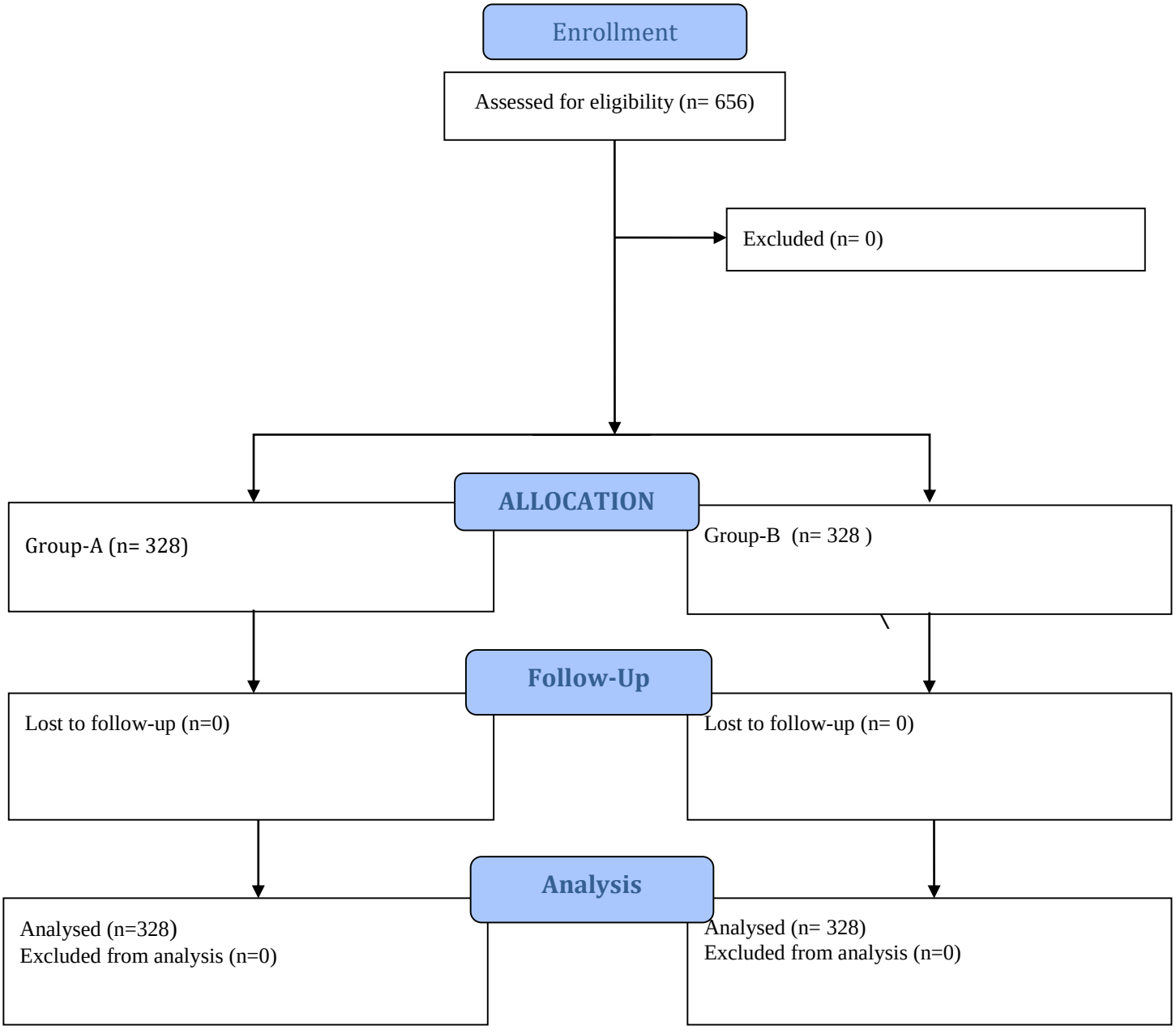
Written informed consent was obtained from all participants. Patients fulfilling the inclusion criteria were randomized into two groups using sealed opaque envelopes (simple randomization). In Group-A, the gall bladder was retrieved through the umbilical port, whereas in Group-B, retrieval was performed via the epigastric port. All procedures were performed by consultant surgeons with comparable experience in laparoscopic cholecystectomy. Standard operative technique and peri-operative antibiotic prophylaxis were applied in both groups.

Surgical site infection (SSI) was defined according to the Centers for Disease Control and Prevention (CDC) criteria (2017). All patients were examined daily during their hospital stay and subsequently followed in the outpatient clinic on the 7th postoperative day and at 30 days. They were instructed to report earlier if they developed fever, wound discharge, redness, or pain at the port site. A structured proforma was used to record clinical findings, including erythema, induration, tenderness, discharge, and need for wound opening or culture. Infections were classified as superficial or deep

incisional according to CDC definitions. Outcome assessment was performed by surgical residents not involved in the index procedure.

Data were analyzed using Statistical Package for Social Sciences (SPSS version 20). Quantitative variables (age, operative time, hospital stay) were expressed as mean ± Standard Deviation and compared using Student's t-test. Qualitative variables i.e, gender, Surgical Site Infection (SSI) occurrence were expressed as frequency and percentage and compared using Chi-square test (or Fisher's exact test where appropriate). A p-value ≤ 0.05 was considered statistically significant. (Figure-1)

Figure-1: Patient Flow Diagram (n=656)



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Results

A total of 656 patients were randomized, with 328 in each group. The mean age of patients was 41.2 ± 10.8 years in the umbilical Group and 40.7 ± 11.1 years in the epigastric group (p=0.58). Both groups were comparable with respect to gender distribution, BMI, operative time, and hospital stay (p>0.05 for all) (Table-I). Surgical site infection (SSI) occurred in 23 patients (3.5%) overall. The frequency was significantly higher in the umbilical group (18/328; 5.5%) compared to the epigastric group (5/328; 1.5%) (p=0.01). The relative risk (RR) of SSI with umbilical port extraction was 3.6 (95% CI: 1.35–9.59) compared to epigastric extraction (Table-II).
All infections were superficial incisional and managed conservatively. No deep infections or reoperations were required.

Table-I: Comparison of Demographic and Clinical Characteristics between the Two Groups

Variable	Umbilical Group (n=328)	Epigastric Group (n=328)	p-value
Age (years), mean ± SD	41.2 ± 10.8	40.7 ± 11.1	0.58
Gender (M/F)	112 / 216	118 / 210	0.62
BMI (kg/m²), mean ± SD	25.9 ± 3.8	25.7 ± 3.9	0.62
Operative time (min), mean ± SD	62.5 ± 11.3	61.8 ± 12.1	0.47
Hospital stay (days), mean ± SD	1.9 ± 0.6	1.8 ± 0.5	0.33

Table-II: Comparison of Surgical Site Infection between Umbilical and Epigastric Port Site Extraction with Relative Risk

Variable	Umbilical Group (n=328)	Epigastric Group (n=328)	p-value
SSI present, n (%)	18 (5.5%)	5 (1.5%)	0.01
SSI absent, n (%)	310 (94.5%)	323 (98.5%)	-
Variable	Umbilical Group (n=328)	Epigastric Group (n=328)	p-value
SSI present, n (%)	18 (5.5%)	5 (1.5%)	0.01
SSI absent, n (%)	310 (94.5%)	323 (98.5%)	-

DISCUSSION

Laparoscopic cholecystectomy has become the gold standard treatment for symptomatic gallstone disease.[10] Nevertheless, complications such as surgical site infection (SSI) still pose a challenge.[11] In laparoscopic cholecystectomy, port-site infection rates are generally lower than in open surgery but remain a notable concern especially when the gallbladder is retrieved through the umbilical port.[12] Among these, the choice of port used for gallbladder retrieval has been a matter of debate, with the umbilical and epigastric ports being the most common options.[13]
The current study showed that the total incidence of SSI was 3.5%, which is in line with the range of 1–7% that has been reported globally after laparoscopic cholecystectomy.[14, 15] This result suggests that port selection affects infection rates independently of other perioperative parameters and has a significant impact on postoperative outcomes. The increased infection rates linked to umbilical extraction have a number of potential causes. First of all, the umbilicus is a naturally populated place that is likely to accumulate moisture and debris, which could encourage the growth of bacteria.[16] Second, because the umbilical port is often the main point of entry, it is subjected to frequent manipulation, which could raise the possibility of contamination.[17] Third, it is frequently necessary to stretch or extend the fascia in order to retrieve the gallbladder through the umbilical incision, which may result in further tissue damage and heightened vulnerability to infection.[18]
The present study demonstrated that surgical site infection (SSI) was significantly higher when the gallbladder was retrieved through the umbilical port (5.5%) compared to the epigastric port (1.5%), with a relative risk of 3.6. These results are consistent with the findings of Anand et al**.** from India found that gallbladder retrieval via the epigastric port was associated with a significantly lower SSI rate (2%) compared to the umbilical port (6%).[19] These findings were further supported by an international meta-analysis conducted by Kulkarni et al., which found that epigastric extraction almost triples the risk of contamination and port-site morbidity.[20] In contrast, certain studies, such as Ali et al., revealed overall lower infection rates (5.3%) without a statistically significant difference between port sites, despite their very small sample size.[21]
The information that is now available indicates that, although some individual studies reveal much higher

SSI at the umbilical port, pooled analyses indicate that depending on local characteristics and surgical practice, infection risk may be equivalent between sites. Heterogeneity in patient groups, perioperative antibiotic regimes and follow-up lengths across various studies may be one reason for this disparity.

The aesthetic effects of port selection must also be taken into account. Shabana H et al. found that single-incision laparoscopic cholecystectomy (SILC) provides better cosmetic satisfaction due to the use of a single umbilical port, this benefit comes at the cost of increased operative time, higher technical demands and greater expense.[22] Therefore, it may be reasonable to prioritize reducing the danger of infection over merely aesthetic factors.

Similar to this, Al-Naser et al. noted that port-site infections are still a significant post-laparoscopic cholecystectomy complication, highlighting the part that intraoperative contamination and port position play in their development.[23]

From a clinical standpoint, this study's results highlight how crucial specimen retrieval site selection is to lowering postoperative morbidity. Gallbladder extractions performed routinely through the epigastric port may reduce infection rates, the need for postoperative wound care, patient discomfort, and medical expenses.

Limitations:

The results of this single-center study might not apply to other groups. Not all suspected infections had standard microbiological cultures, which may have revealed more information about the organisms causing the infection. Another limitation, the 30-day follow-up period may have missed very late-onset port problems, although it was sufficient for the majority of superficial SSIs. The study offers compelling evidence in favor of the epigastric location for gallbladder extraction, notwithstanding these drawbacks.

CONCLUSION

Gallbladder retrieval through the umbilical port was associated with a significantly higher rate of surgical site infection compared to the epigastric port.

Acknowledgement: None.

Consent and Ethics permission: Ethical approval was obtained from the Institutional Review Board with a reference number 704/2025.

Conflict of interests: None.

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