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Prophylaxis Strategies and Postoperative Complication Profiles in Open Versus Laparoscopic General Surgery: A Prospective Comparative Study at a Multidisciplinary Clinic

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Abstract

Background: Surgical site infections and organ-specific complications are major sources of postoperative morbidity. The surgical approach — open or laparoscopic — significantly influences complication incidence. This study compared complication profiles between the two approaches across diverse general surgical procedures. Methods: A prospective study enrolled 76 consecutive adult patients (38 open, 38 laparoscopic) at the Fergana Medical Institute of Public Health between January 2022 and December 2024, undergoing cholecystectomy, appendectomy, hernia repair, or colonic resection. Standardized prophylaxis protocols were applied uniformly. Outcomes were classified using the Clavien–Dindo system and analyzed with chi-square and t-tests ($p < 0.05$). Results: The overall complication rate was significantly higher in the open group (52.6% vs. 21.1%; $p = 0.005$). Surgical site infections occurred in 21.1% of open cases versus 5.3% of laparoscopic cases ($p = 0.040$). Mean hospital stay was 7.4 days for open surgery versus 3.8 days for laparoscopic surgery ($p < 0.001$). Conclusion: Laparoscopic general surgery is associated with substantially fewer postoperative complications and shorter hospital stay, reinforcing the case for minimally invasive access where technically feasible.

Keywords: *general surgery; surgical site infection; postoperative complications; laparoscopic surgery; surgical prophylaxis; Clavien–Dindo classification*

Introduction

General surgery encompasses a broad spectrum of abdominal, gastrointestinal, and wall-reconstructive procedures, all of which carry an inherent risk of postoperative morbidity. Surgical site infections (SSIs), haemorrhagic events, thromboembolic complications, and physiological derangements collectively contribute to prolonged hospitalization, increased healthcare expenditure, and diminished patient quality of life [1–3]. In high-income settings, SSI rates following clean-contaminated procedures range from 3% to 20% [2,4], whereas limited-resource environments may report

substantially higher figures, particularly where prophylactic protocols are inconsistently applied [3].

The introduction of laparoscopic techniques over the past three decades has transformed surgical practice. Minimally invasive access reduces parietal trauma, attenuates the systemic inflammatory response, and shortens wound exposure time — factors collectively associated with lower rates of SSI and faster recovery [11–15]. Nonetheless, the adoption of laparoscopy in lower-middle-income countries, including Uzbekistan, remains uneven, partly because comparative outcome data from regional institutions are scarce.

Prophylaxis in surgical patients integrates antimicrobial prophylaxis (AMP), antithrombotic prophylaxis, and structured analgesia into unified perioperative pathways [5,6,27]. Guidelines from the World Health Organization [3], the U.S. Centers for Disease Control and Prevention [2], and the American College of Chest Physicians [27] provide the evidence base; however, guideline adherence in Central Asian hospitals has not been systematically evaluated.

The Fergana Medical Institute of Public Health (FMIOPH) operates a multidisciplinary surgical clinic serving a large urban and semi-rural catchment in the Fergana Valley of Uzbekistan. The clinic performs both open and laparoscopic procedures for cholecystectomy, appendectomy, inguinal hernia repair, and colonic resection. The present study was designed to quantify differences in complication rates and prophylactic outcomes between the two surgical modalities within this real-world institutional context, thereby generating locally applicable evidence to guide protocol refinement.

Methods

Study Design and Setting

A prospective comparative cohort study was conducted at the multidisciplinary surgical clinic of FMIOPH, Fergana, Uzbekistan, between January 2022 and December 2024. The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional ethics committee. All participants provided written informed consent.

Participants

Consecutive adult patients (≥18 years) scheduled for elective or urgent abdominal surgery were screened for eligibility. Inclusion criteria were: indication for cholecystectomy (symptomatic cholelithiasis or acute cholecystitis), appendectomy (acute appendicitis), inguinal hernia repair, or segmental colonic resection; ASA physical status I–III; and ability to provide informed consent. Exclusion criteria included emergency laparotomy for perforation or obstructive ileus,

immunosuppressive therapy, malignancy requiring oncological staging, and conversion from laparoscopic to open surgery (three conversions were excluded from analysis). Thirty-eight patients were allocated to each surgical arm.

Surgical Procedures and Prophylaxis

Procedures performed in the open group included cholecystectomy (n=14), appendectomy (n=10), inguinal hernia repair (n=8), and left hemicolectomy (n=6). The laparoscopic group underwent the same spectrum: laparoscopic cholecystectomy (n=15), laparoscopic appendectomy (n=10), totally extraperitoneal hernia repair (n=8), and laparoscopic-assisted colonic resection (n=5). A standardized institutional prophylaxis protocol was applied in both groups: intravenous cefazolin 2 g administered 30–60 minutes before incision [5]; low-molecular-weight heparin (enoxaparin 40 mg subcutaneously) initiated the evening before surgery and continued until full ambulation or hospital discharge [27]; and multimodal analgesia comprising paracetamol, NSAIDs, and regional techniques to minimize opioid use in line with enhanced recovery principles [8,9].

Outcome Measures

The primary outcome was overall complication rate within 30 days of surgery. Secondary outcomes included: SSI (superficial, deep, or organ/space); wound dehiscence; postoperative ileus (defined as absence of flatus and distension beyond 72 hours); haemorrhage/haematoma requiring intervention; deep-vein thrombosis or pulmonary embolism confirmed by imaging; urinary retention; length of hospital stay; and 30-day readmission. Complications were graded using the Clavien–Dindo classification [19,20].

Statistical Analysis

Data were entered into SPSS version 26.0 (IBM Corp., Armonk, NY). Categorical variables were expressed as counts and percentages and compared with Pearson chi-square or Fisher exact tests, as appropriate. Continuous variables were expressed as mean ± standard deviation and compared with independent-samples t-tests. Odds ratios with 95% confidence intervals were calculated for each complication. The Bonferroni correction was applied for multiple comparisons; a two-tailed $p < 0.05$ was considered statistically significant.

Results

Patient Characteristics

The two groups were comparable with respect to age (open: 44.2 ± 13.7 years; laparoscopic: 42.6 ± 12.9 years; $p = 0.577$), sex distribution (male 52.6% vs. 57.9%; $p = 0.636$), ASA class, and procedural mix. No statistically significant intergroup differences were observed in baseline comorbidities (diabetes mellitus, arterial

hypertension, or smoking) or preoperative laboratory parameters, confirming adequate group comparability.

Complication Rates

Detailed complication data are presented in Table 1 and illustrated in Figure 1. The overall 30-day complication rate was significantly higher in the open surgery group (20/38, 52.6%) than in the laparoscopic group (8/38, 21.1%; OR 4.29, 95% CI 1.54–11.9; p = 0.005). SSIs were documented in 8 open-group patients (21.1%) versus 2 laparoscopic-group patients (5.3%; p = 0.040; OR 4.71). Wound dehiscence occurred in 5 open versus 1 laparoscopic patient (13.2% vs. 2.6%; p = 0.093). Postoperative ileus was observed in 7 open versus 3 laparoscopic patients (18.4% vs. 7.9%; p = 0.175). Haemorrhagic events and DVT/pulmonary embolism were rare but numerically more common in the open group. Urinary retention affected 4 open-group patients (10.5%) and 2 laparoscopic patients (5.3%; p = 0.391). Mean hospital stay was significantly shorter in the laparoscopic group (3.8 ± 1.4 days vs. 7.4 ± 2.1 days; p < 0.001). Thirty-day readmission rates were 10.5% (open) and 2.6% (laparoscopic), a difference that did not reach significance (p = 0.165).

Table 1.

Postoperative complications and outcomes stratified by surgical approach

Complication		Open n (%)	Laparosc. n (%)	p-value	OR (95% CI)
Surgical site infection		8 (21.1)	2 (5.3)	0.040	4.71 (0.95–23.3)
Wound dehiscence		5 (13.2)	1 (2.6)	0.093	5.69 (0.63–51.3)
Postoperative ileus		7 (18.4)	3 (7.9)	0.175	2.63 (0.64–10.8)
Haemorrhage / haematoma		4 (10.5)	2 (5.3)	0.391	2.10 (0.37–12.0)
DVT / pulmonary embolism		3 (7.9)	1 (2.6)	0.306	3.21 (0.31–32.7)
Urinary retention		4 (10.5)	2 (5.3)	0.391	2.10 (0.37–12.0)
Overall complications		20 (52.6)	8 (21.1)	0.005	4.29 (1.54–11.9)

Complication		Open n (%)	Laparosc. n (%)	p-value	OR (95% CI)
Hospital stay, days (mean)		7.4 ± 2.1	3.8 ± 1.4	<0.001	–
Readmission within 30 d		4 (10.5)	1 (2.6)	0.165	4.44 (0.47–42.4)

OR = odds ratio; CI = confidence interval; DVT = deep-vein thrombosis. p-values from Pearson chi-square or Fisher exact test; hospital stay compared with independent-samples t-test.

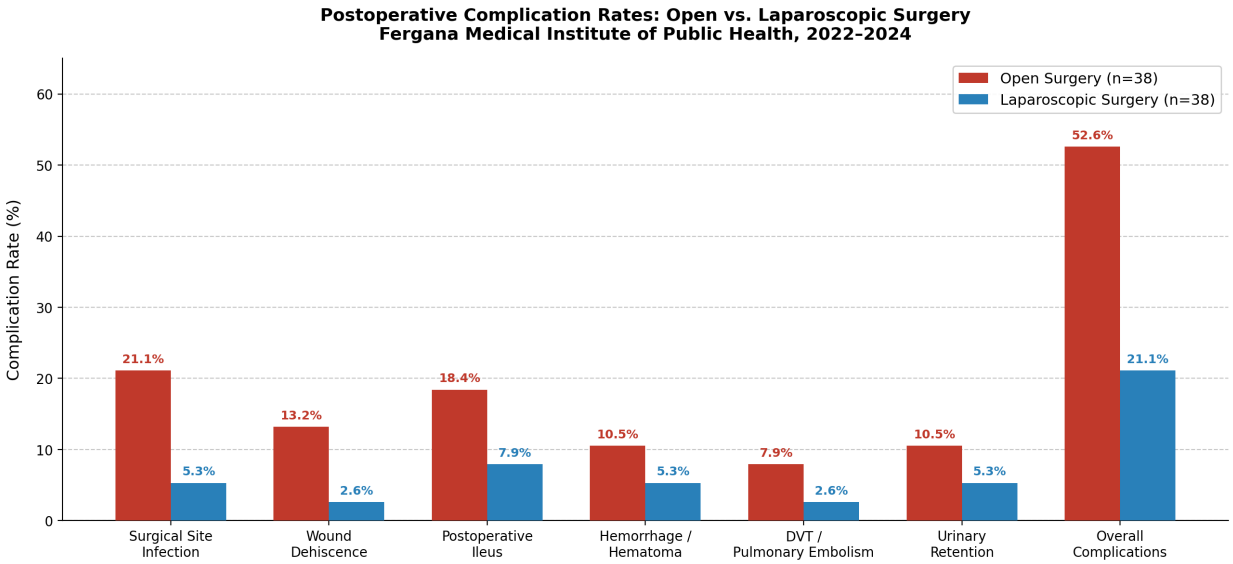

Figure 1. *Postoperative complication rates (%) by surgical approach and complication type*

Red bars = open surgery (n=38); blue bars = laparoscopic surgery (n=38). FMIOPH, Fergana, 2022–2024.

Discussion

The principal finding of this study is that laparoscopic general surgery was associated with a fourfold reduction in the odds of experiencing any postoperative complication relative to open surgery, despite identical prophylactic protocols. This finding aligns with a large body of international literature. Cirocchi et al. [11] demonstrated in a meta-analysis that laparoscopic appendectomy significantly reduces SSI rates versus open appendectomy, and Gurusamy and Samraj [12] reported analogous benefits for laparoscopic cholecystectomy. The mechanisms underlying reduced morbidity with laparoscopy include smaller wound surface area, lower intraoperative evaporative loss, attenuated neuroendocrine stress response, and preservation of peritoneal immune defences [14,15].

SSI was the most prevalent complication in the open group (21.1%), consistent with published benchmark rates for clean-contaminated open abdominal procedures [7,22]. The magnitude of the difference (21.1% vs. 5.3%) underscores the wound-protective

effect of minimally invasive access. The WHO [3] and CDC [2] guidelines emphasize that antibiotic prophylaxis and surgical technique are complementary SSI prevention strategies; our data confirm that technique contributes substantially, even when prophylaxis is protocol-driven and uniform across groups. Skin preparation with chlorhexidine-alcohol, normothermia maintenance, and wound protector devices — elements of WHO-recommended SSI bundles [4] — may further reduce open-surgery SSI rates and warrant prospective evaluation at our institution.

Postoperative ileus was more than twice as frequent in the open group (18.4% vs. 7.9%). Gut manipulation, peritoneal desiccation, and morphine requirement — all amplified in open surgery — trigger prolonged adrenergic inhibition of colonic motility [8]. Enhanced recovery after surgery (ERAS) protocols, which limit bowel handling and emphasize early enteral feeding and opioid-sparing analgesia [9], represent the strongest evidence-based countermeasure. Our multimodal analgesia protocol incorporated ERAS principles, yet did not fully neutralize the motility impairment associated with open laparotomy, reflecting the primacy of surgical access in ileus pathogenesis.

Thromboembolic events were rare (DVT/PE: 3 open, 1 laparoscopic), attributable in part to consistent enoxaparin prophylaxis administered in accordance with ACCP guidelines [27,28]. However, longer operative times and enforced bed rest in the open group elevate the theoretical thromboembolic risk, and early ambulation protocols — achievable within 4–6 hours of laparoscopic procedures in our series — serve as a pivotal mechanical adjunct to pharmacological prophylaxis. Geerts et al. [27] demonstrated that combined pharmacological and mechanical prophylaxis yields additive benefit over either modality alone.

Hospital stay differed by nearly four days between groups (7.4 vs. 3.8 days), closely mirroring results from Bardram et al. [10] in elderly laparoscopic cholecystectomy patients and the rapid rehabilitation data summarized by Kehlet and Wilmore [8]. Shorter hospitalizations carry direct economic implications: Lissovoy et al. [22] estimated that each SSI adds approximately USD 10,000 to acute-care costs, suggesting that the institutional cost of laparoscopic investment is likely recouped through reductions in complication-driven expenditure.

Several limitations of this study warrant acknowledgment. The single-centre design and moderate sample size (38 per arm) limit generalizability and statistical power for rare individual complications. The procedural mix, although comparable between arms, was not randomized; selection bias could influence results if surgeons preferentially selected lower-risk patients for laparoscopy. Additionally, three conversions from laparoscopic to open surgery were excluded, which may marginally overestimate laparoscopic performance. Future multicentre randomized trials with

systematic Clavien–Dindo grading and patient-reported outcomes are needed to strengthen the evidence base in the Central Asian context.

Conclusion

This prospective institutional study demonstrates that laparoscopic general surgery is associated with significantly lower overall postoperative complication rates, including SSI and prolonged ileus, and markedly shorter hospital stay compared with open surgery, despite the application of identical antibiotic, antithrombotic, and analgesic prophylaxis protocols. These findings support the broader adoption of minimally invasive surgical techniques within the multidisciplinary setting of the Fergana Medical Institute of Public Health. Simultaneously, they affirm that rigorous adherence to evidence-based prophylaxis pathways is essential for both surgical modalities. Institutional investment in laparoscopic infrastructure, combined with structured ERAS implementation, offers the greatest synergistic benefit for postoperative outcomes in the Fergana Valley region.

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