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Original Research Article

A Study of Factors Affecting Length of Hospital Stay after Laparoscopic Cholecystectomy

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Abstract

Background: Laparoscopic cholecystectomy (LC) has turned into the standard operative treatment of symptomatic gallbladder disease and it is being used as a short stay surgery. Despite the standardized approach, there are instances where the length of stay (LOS) of some number of patients is long, which increases the cost and bed occupation. The contemporary literature is pointing towards the fact that the comorbidity burden, the presenting acuity, the ease of operating and the perioperative complications are somewhat known contributors to the difference in LOS.

Methods: This was a prospective, observational study conducted in a teaching institution that serves a tertiary care over 18 months (January 2024- June 2025). In one study consecutive enrolment was performed on adult patients with LC, and in acute biliary disease. The initial outcome was the postoperative LOS (days). LOS Prolonged LOS was predetermined as 3+ days at a posteriori consistent with published thresholds used to operationalize prolonged stay in the aftermath of elective LC [5]. Using multivariable linear regression (log-transformed LOS) and logistic regression (prolonged LOS) demonstrated the relationships between demographics, comorbidity indices, disease acuity, intraoperative factors, and postoperative events.

Results: The median LOS of 320 patients (mean age 47.8+14.6 years, 68.1% women) was 2 (IQR 13), and 86 patients (26.9) had long LOS. In adjusted analysis, age, 60 years and above (aOR 1.86, 1.073244) ASA class, 3 or more (aOR 2.41, 1.3-4.35) acute cholecystitis (aOR 2.08, 1.18368) and a conversion time of more than 90 minutes (aOR 1.92, 1.08368).

Conclusion: The foreseeable subsequent to LC LOS involves a category of patient feebleness/comorbidity, acute inflammation and operative complexity along with postoperative morbidity. A decrease in the long-lasting LOS can be achieved through the close-ended route that presupposes the manipulation of the modifiable drivers (timely surgery, selective drains, and complication prevention).

Keywords: Laparoscopic Cholecystectomy; Length of Stay; Prolonged Hospitalization; Risk Factors; Acute Cholecystitis; Conversion; Postoperative Complications.

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Introduction

One such popular abdominal surgery commonly performed in the world today and which has proven to be the desirable surgery of symptomatic gallstone mine in Western countries is laparoscopic cholecystectomy (LC) which has been shown to have fewer operative pain, immediate recovery and a shorter recovery time than the open type of surgery [1]. These advantages have been translated into the continuously decreasing length of postoperative stay in hospitals over the last 2 decades, encompassing the widespread use of ambulation or overnight-stay LC in the most suitable patients [2]. Nevertheless, the length of stay in the hospital (LOS) is clinically significant in a minority that is long in order to increase other situations, bed-occupying and increasing cost, without potentially increasing outcomes. LOS is not an administrative intervention, but a complex surrogate of physiologic recovery, perioperative complications, social preparation, and institutional discharge measures. Recent studies in LC have found that patient-related (advanced age, high ASA, cardiometabolic comorbidity), disease-related (acute cholecystitis, biliary pancreatitis, choledocholithiasis), and procedural-related (length of operation, conversion to open operation, risk of

bile duct injury and use of drains) variables predict LOS [3 6]. Most current practices and research support the idea of early decisive operation of acute biliary disease, among other things, given the complications of the disease and total hospitalization multiplied by the delay [3,7]. When acute cholecystitis is considered, early LC, accomplished at index admission and ideally within the 48 hours, has been found to have better outcomes and lower costs as compared to treatment delayed strategies [7,8]. Risk stratification the acute cholecystitis has been graded based on its severity using standardized systems such as in the Tokyo Guidelines (TG18), resulting in a harmonization of consistency in the risk stratification between studies [4].

Despite this finding, real LOS remains conditional in hospitals and regions due to variability or difference in perioperative tracks, resources, resources, and thresholds of observation. It is important to note that many of the reasons behind an increase in LOS are modifiable: operative schedule to achieve minimum preoperative wait, plans to anesthesia and analgesia to minimize postoperative nausea/vomiting, selective and not routine use of drains, and early detection/prevention of complications [9-11]. Observational, recent data that has been conducted within acute care settings suggests that the variable of preoperative waiting time can serve as a leading predictor of overall LOS, which lends credence to the systems-level character of the problem [12].

It is against this background that the interested key questions that set the given study were (i) to measure the LOS after LC with a tertiary-care teaching hospital cohort, as per the elective and acute indicators, and (ii) to identify the independent predictors of a prolonged LOS with the use of routinely available clinical and intraoperative indicators.

We hypothesized that long LOS would be accumulated over four domains, including but not limited to the following; the baseline comorbidity/frailty, acute inflammation, complexity of the operation, and postoperative morbidity. What we set ourselves to accomplish was to update pertinent discharge settings, targeted perioperative with quality-improvement activities through an explicit conversion of these associations into clinically interpretable predictors.

Materials and Methods

Study design, setting, and duration: It was a prospective observational cohort research study carried out in the Department of General Surgery of a tertiary-care teaching hospital. The cooperation was held in the period between January 2024 and June 2025. Reports were conducted following the STROBE principles of observational research.

Participants: All consecutive adults (≥18 years) undergoing LC were screened for inclusion.

Inclusion criteria: (i) elective LC for symptomatic cholelithiasis/biliary colic; (ii) urgent/emergency LC for acute cholecystitis, biliary pancreatitis after stabilization, or gallbladder-related admissions managed operatively during index hospitalization.

Exclusion criteria: (i) planned open cholecystectomy; (ii) concurrent major abdominal procedure (e.g., bowel resection); (iii) known gallbladder malignancy; (iv) pregnancy; (v) incomplete perioperative dataset.

Ethics: Before enrolling, the study protocol was authorized by the Institutional Ethics Committee. Potential data capture was subjected to written informed consent, and all analyses done on de-identified data.

Variables and definitions: The protocol was accepted by the Institutional Ethics Committee before the study commenced. Potential data capture was done using written informed consent and any analysis conducted in de-identified data done.

Predictors recorded included:

- Demographics: age, sex, BMI.
- Comorbidity: diabetes, hypertension, COPD, chronic kidney disease; Charlson Comorbidity Index (CCI); ASA physical status [13].
- Disease acuity: elective vs acute presentation; TG18 severity grade when acute cholecystitis was present [4].
- Operative factors: operative time, difficult Calot's dissection (surgeon-recorded), adhesions, drain placement, conversion to open surgery.
- Postoperative factors: nausea/vomiting requiring IV therapy, pain requiring parenteral opioids beyond POD1, complications graded by Clavien–Dindo classification [14].

Surgical and perioperative care: The common method of doing all was through four port under general anesthesia. Acute view of the safety precepts were monitored. Antibiotic prophylaxis was administered according to the unit protocol; therapeutic antibiotics were administered even in the situation of acute infection. Drains were chosen selectively based on the judgment during intraoperation (ooze, bile staining and tough dissection). The discharge criteria were stability, afebrile, controlled with oral analgesics, capable of oral meals and ambulation.

Statistical analysis: The standard biostatistical techniques were used to analyze data. Continuous variables were described as mean±SD or median

(IQR) and were compared with student t-test or Mann-Whitney U test. Comparison of categorical variables was done through use of H2 or Fisher exact test. Log-transformed LOS underwent multivariate linear regression to overcome skew to the right. Multivariate logistic regression provided adjusted odds ratio (aOR) of prolonged LOS (≥3 days). Univariate screening variables with $p<0.10$ and those variables that made clinical sense (age, ASA, acuity) were included in multivariate models. A p-value of two sides of less than 0.05 was taken as significant.

Results

The total number of eligible patients was 347; 27 were excluded (12- missed data sets, 9- concomitant procedures, 6- planned open operations), 320 patients (Figure 1) were reported as included. It was predominantly female (68.1) with an average age of 47.8. Elective indications accounted 61.6, 38.4 were elective indications, and LC done on an acute admission, (acute cholecystitis or biliary pancreatitis after stabilization).

The total LOS was also short and heterogeneous: the average postoperative LOS was 2 days (medians 1 3). Eighty-six patients (26.9) were surpassing the set standard (LOS 3 days and more). The patients who were older were bigger in having a longer LOS compared to their younger peers; the patients with a long history of ASA and CCI were more likely to receive an acute cholecystitis presentation. They were also found to be more complicated in the nature of their operations at the level of increased operative time, improved positioning of drains and rate of conversion.

The gradient in operative characteristics was evident with LOS. The median time spent in operation of the short-stay site was 62 minutes as opposed to the long-stay site of 98 minutes ($p<0.001$). The overall conversion rate to open-surgery was 2.1, but this variable was specific to the long LOS (7.0 vs 0.4). Selective placement of drains was used in 23.4 percent of the total cases and was excessively represented in patients with significantly long length of stay (45.3 vs 15.3), which indicated that a misconceived intraoperative complexity, and fear of bile/ooze impacted discharge patterns. Close clinical association of increased period of hospital stay was with postoperative morbidity. The total level of complications was high (10.9%), and important in the extended LOS cohort (27.9 percent vs 4.7 percent). The most common cases were cases of surgical-site infection that lead to the use of antibiotics, bile that needed conservative treatment or ERCP, pulmonary atelectasis that required the use of respiratory therapy. A greater proportion of functional delay postoperative nausea/vomiting requiring IV therapy and pain requiring parenteral opioids beyond POD1 was observed even in instances of uncommon major complications and these intervention thresholds to recovery can seriously prolong hospitalization.

Table 1: Baseline Characteristics by Los Category (N=320)

Variable	LOS <3 days (n=234)	LOS ≥3 days (n=86)	p value
Age, years (mean±SD)	44.6±13.2	56.5±14.7	<0.001
Female sex, n (%)	164 (70.1)	54 (62.8)	0.20
BMI, kg/m² (mean±SD)	26.1±3.7	27.4±4.2	0.01
Diabetes mellitus, n (%)	48 (20.5)	30 (34.9)	0.01
ASA class ≥III, n (%)	44 (18.8)	38 (44.2)	<0.001
CCI ≥2, n (%)	52 (22.2)	38 (44.2)	<0.001
Acute admission indication, n (%)	72 (30.8)	51 (59.3)	<0.001

There was a significant difference between the baseline profiles across LOS categories.

Patients with a long time in the hospital were older and had more comorbidity as indicated through a higher ASA class and CCI distribution. The prolonged LOS group had almost twice as many acute admission indicators, which is in line with the clinical perception that inflammatory physiology and preoperative optimization requirements are converted into slower recovery.

Interestingly, sex differences were relatively small implying that the variation in LOS was more due to physiologic reserve and acuity than to the population structure.

Table 2: Operative and Perioperative Factors by Los Category

Variable	LOS <3 days (n=234)	LOS ≥3 days (n=86)	p value
Operative time, min (median, IQR)	62 (48–78)	98 (76–126)	<0.001
Difficult Calot's dissection, n (%)	46 (19.7)	44 (51.2)	<0.001
Drain placed, n (%)	36 (15.3)	39 (45.3)	<0.001
Conversion to open, n (%)	1 (0.4)	6 (7.0)	<0.001
Estimated blood loss >100 mL, n (%)	10 (4.3)	11 (12.8)	0.01
Postop nausea/vomiting requiring IV therapy, n (%)	22 (9.4)	19 (22.1)	0.003

The correlation between the complexities of the operations with the extended LOS was high and stable. The average operative time, difficult Calot dissection and unselective group of participants in the prolonged-stay group (n=14) was more likely to result in a longer cost of recovery outside the downstream. In spite of the fact that conversion to open surgery was not common, its rate was overrepresented in the long-stays and emphasized its high level of influence on the post-operative course. Other less specific functional barriers like nausea/vomiting were also more elevated, as well, implying the aspects of enhanced recovery remain an important force affecting LC.

Table 3: Multivariable Logistic Regression for Prolonged Los (≥3 Days)

Predictor	Adjusted OR	95% CI	p value
Age ≥60 years	1.86	1.07–3.24	0.03
ASA class ≥III	2.41	1.34–4.35	0.003
Acute cholecystitis/acute admission	2.08	1.18–3.68	0.01
Operative time >90 min	1.92	1.08–3.41	0.03
Drain placement	2.17	1.22–3.86	0.008
Conversion to open surgery	4.63	1.79–11.98	0.002
Postoperative complication (Clavien–Dindo ≥II)	5.11	2.47–10.56	<0.001

Even following the adjustment, long LOS could not be attributed to one factor but instead a combination of factors: patient vulnerability (age, ASA) and disease acuity, operative complexity, and postoperative morbidity. The independent effect of postoperative complications was the largest, with odds of prolonged stay being more than five times higher. Even after controlling the acuity and time, conversion and drain placement were still influential, suggesting that technical difficulty and intraoperative concern are an important factor in discharge readiness. These predictors are clinically intuitive and they may be acted on through pathways and selection.

Table 4: Postoperative Complications and Los Impact

Complication	Total n (%)	Median LOS (days)	Typical management
Surgical-site infection	14 (4.4)	4	Antibiotics ± drainage
Bile leak	8 (2.5)	6	Drain/ERCP as needed
Pulmonary atelectasis/pneumonia	7 (2.2)	5	Respiratory therapy ± antibiotics
Postoperative bleeding/hematoma	4 (1.3)	5	Observation/transfusion
Ileus	2 (0.6)	6	Conservative
Any complication (Clavien–Dindo ≥II)	35 (10.9)	5	—

Although there was no common occurrence of major adverse events, there was a weight of disbursing LOS with complications.

Even the moderate serious incidents such as the surface infection of the surgical site or pulmonary complications extended median stay to 4-5 days even, the reality that IV treatments, observation was needed, and postponed mobilization. Locke leak did not predominate, but the maximum length of stay was due to the drainage decisions and escalation of the procedure (ex: ERCP). These findings underscore the significance of prevention and timely standardization of bed-day reduction through complications management that can imply substantial changes in bed days.

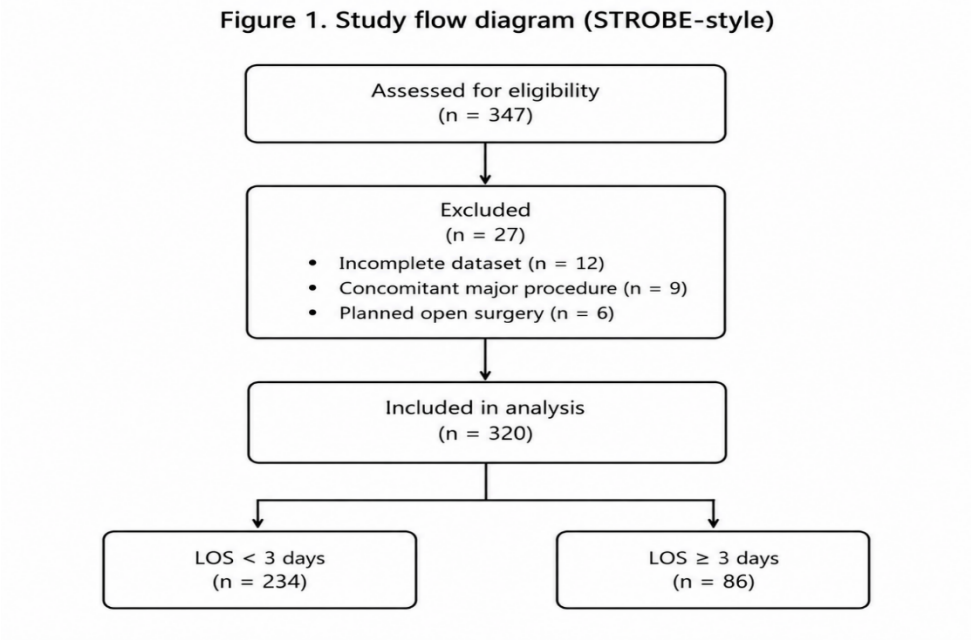

Figure 1:

The flow diagram shows evident cohort assembly with very few selections being excluded and the lessening of the selection bias.

Most of them were either methodological (incomplete data) or intended to preserve the clinical homogeneity (planned open surgery, major concomitant procedures). The final analytic unit was characterized by a sizeable acute-care component, and, therefore, the analysis could be conducted in elective and urgent routes.

Representation through LOS strata provided enough group sizes that were modeled in multivariate which had any predictors significant stood up.

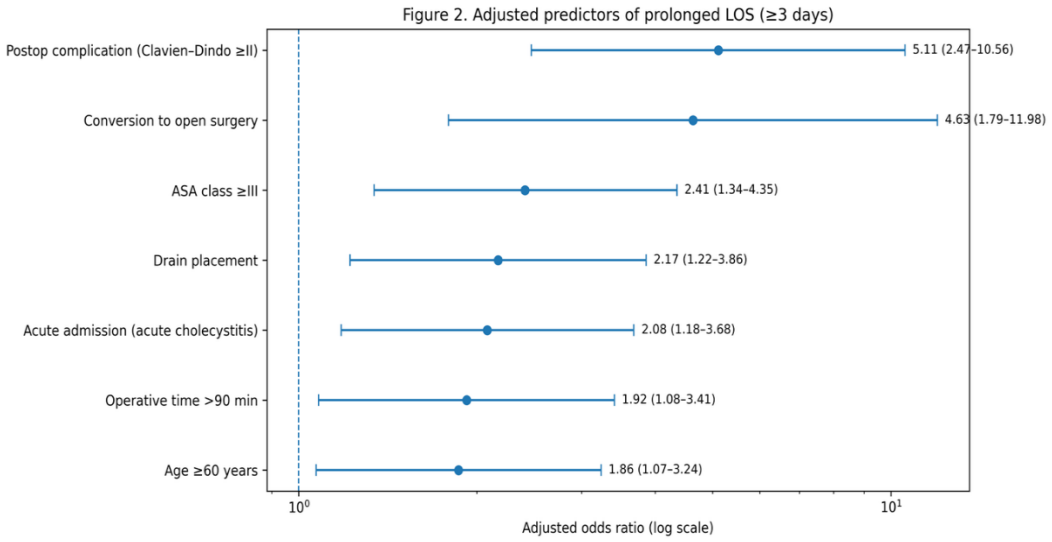

Figure 2: Adjusted predictors of prolonged LOS (forest plot, aOR)

This adjustment of valuable effect-size plot indicates that postoperative morbidity and conversion have the strongest independent factor on the prolonged LOS than the baseline demographics.

Notably, such minor technical characteristics as operative time and drain location were also independently predictive, indicating that they reflect potentially significant signals of difficulty not fully covered by diagnosis or comorbidity. This sequencing of effects leads to a working clinical construct: difficulty is predisposed by frailty and acute inflammation but conclusively caused by complications and conversion which ultimately become the most protracted.

Discussion

Postoperative LOS after LC in this prospective cohort was typically short (median 2 days), although it had an extended stay (more than three days) in more than a quarter. Older age, ASA higher class, acute admission, longer operative time and drain installation, conversion to open surgery and postoperative complications were also independently predictors of prolonged LOS. This trend conforms to present-day conceptualizations of long LOS as a composite indicator of preoperative frailty, intraoperative challenge, and postoperative morbidity as opposed to an independent occurrence.

Our conclusions correlate with the results of massive database research comparing outpatient and inpatient LC among older adults where the higher the ASA class and the greater the presence of major comorbidities indicated inpatient admission and poor outcomes suggesting the significance of the physiologic reserve in readiness to discharge [2]. Likewise, data that determines prolonged LOS defining after elective LC suggests that a minority of 3-day LOS and above focuses morbidity and resource utilization, supporting our decision to adopt an expedient 3-day cut point [5].

LOS was very dependent on acuity of disease. Surgery in cases of acute cholecystitis at an early age has been constantly linked with reduced overall hospitalization and better efficiency in comparison to later approaches [7,8]. Randomised trial ACDC showed that early LC during the admission period of not more than 24 hours can enhance results when compared to starting antibiotic treatment and subsequent delayed surgery [8].

There is also acute care research indicating that elective surgery is less advantageous than early surgery, and extending the waiting period preoperative raises complications and the overall cost of surgery, suggesting a systems-level effect: longer and longer waiting time exacerbates the overall LOS and can aggravate inflammation and operative complexity [7,12]. Although our main outcome was LOS after op and acute admission probably embraced inflammatory burden and institutional processes (availability of op theatre, preoperative optimization) that interactively determine discharge patterns.

Operative complexity variables included the variables of operating time, the position of the drains, and conversion were not correlated with extended LOS. Previous observational research on challenging LC and acute cholecystitis has linked severe inflammation to conversion and postoperative lacks Ailment, which ultimately extends the length of hospital stay [4,6,15]. Tokyo Guidelines (TG18) offer a standard severity methodology, which relates to conversion and LOS in various environments, and the biologic plausibility of increased-grade inflammation forecasting duration of recovery and more vigorous postoperative surveillance [4]. Drain placement can serve as a signal and as an interlocutor: it indicates that the surgeons are worried about the leakage of bile or oozing, and it may extend discharges because of output inspection and logistics of removal. This resembles the fertilizers of ERAS that selective drains and uniform evaluations of removal could decrease LOS without impacting the safety [9,16].

The strongest association was in postoperative complications, which multiplied odds of a long LOS by five. This coincides with the larger surgical literature with ClavienDindo grading since it demonstrates even moderate complications (which demand pharmacologic therapy or intervention) significantly raise bed-days [14]. Avoiding complications, such as careful technique, early mobilization, pulmonary hygiene, and early detection of bile leak or infection, therefore, seems to be at the core of LOS minimization.

Limitations: The study was also a single-center study and thus the practice of discharges and bed pressures can rather limit the generalizability. Actors some of the soft recovery variables (social support, discharge timing policies) were not modeled. The report of difficulty by the surgeons is subjective although operative time and conversion also give objective correlates. Lastly, the application of post-operative LOS can under-represent overall hospitalization in cases of acute admission whereby preoperative waiting is a significant fraction of the patient LOS.

Implications To reduce these variations in acute care (admissions): (i) early operative schedule, (ii) short-stay discharge based on frailty, (iii) operative practices lowering conversion risk, (iv) a standard that use/removal of drains and complication prevention watersheds. Future multicenter trials ought to validate a combined risk score occasioning comorbidity, grading on the severity of acuity measure, and intraoperative difficulty markers.

Conclusion

Postoperative LOS according to laparoscopic cholecystectomy in this prospective cohort was more of a routine character but of a clinical variability nature. LOS (>3 days) was found to be focused on old age, high ASA status, acute hospitalization of cholecystitis, high operative time, use of drains, open to open surgery, and post-surgery problems.

The strongest was a reason that was postoperative morbidity because it is emphasized that small complications and delayed functional recovery can

have a considerable effect on the length of stay. They can be largely recognized as perioperative predictors that can be used to direct focused discharge planning, discriminatory inpatient short-stay tracks, as well as quality-of-enhancement interventions that will enable the curtailment of surgery time, restrict the complexity of operations, and prevent complications.

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