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Research Article

Clinical Outcomes of laparoscopic cholecystectomy in Patients with cholelithiasis

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Abstract

Background: Laparoscopic cholecystectomy has replaced open cholecystectomy as the standard treatment for symptomatic cholelithiasis, offering reduced postoperative pain and shorter hospital stay while carrying a small but persistent risk of conversion to open surgery and bile duct injury [7,11].

Objective: This study reports a single-center clinical outcomes series of laparoscopic cholecystectomy for symptomatic cholelithiasis, describing conversion rate, perioperative morbidity, and length of stay against published benchmarks.

Methods: We retrospectively reviewed 240 consecutive adult patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis, with critical-view-of-safety dissection and conversion decided intraoperatively per standard safe-cholecystectomy criteria [20].

Results: Laparoscopic cholecystectomy was completed in 95.4% of patients; conversion was required in 4.6%, most often for acute cholecystitis or higher ASA class [17]. Overall morbidity was 7.1%, with major bile duct injury in 0.4% of patients, and mean length of stay was 1.9 days after laparoscopic completion versus 5.3 days after conversion [12,29].

Conclusions: Outcomes in this cohort were consistent with published benchmarks, supporting laparoscopic cholecystectomy as the standard of care for symptomatic cholelithiasis and underscoring the continued value of the critical view of safety and a low threshold for conversion [13,30].

Keywords: laparoscopic cholecystectomy; cholelithiasis; conversion to open surgery; bile duct injury; postoperative outcomes

1. Introduction

Cholelithiasis is among the most common gastrointestinal disorders encountered in general surgical practice, with population prevalence estimates ranging from roughly 10-15% in Western cohorts and marked variation by sex, age, and ethnicity [1,2]. The natural history of gallstone disease was characterized by early longitudinal cohorts such as the Sirmione study, which followed an initially asymptomatic population for a decade and quantified the annual rate at which silent stones become symptomatic [3], and by the Multicenter Italian Study on Cholelithiasis, which established population-level prevalence and risk-factor data across a large sample [4]. Cholesterol supersaturation of bile, gallbladder hypomotility, and accelerated cholesterol nucleation together drive stone formation, and the resulting clinical spectrum ranges from asymptomatic incidental stones to biliary colic, acute cholecystitis, choledocholithiasis, and gallstone pancreatitis [5,6].

Laparoscopic cholecystectomy transformed the surgical management of symptomatic cholelithiasis within a few years of its introduction in the late 1980s. Early comparative series established shorter hospital stay, less postoperative pain, and faster return to normal activity relative to open cholecystectomy, and a National Institutes of Health consensus conference formally endorsed the laparoscopic approach as the treatment of choice for most patients with symptomatic gallstones [7]. Soper and colleagues, reporting one of the first large single-institution comparative experiences, described laparoscopic cholecystectomy as the new "gold standard" for benign gallbladder disease on the strength of its morbidity and recovery profile relative to laparotomy [8], a judgment corroborated by subsequent contemporary series of open cholecystectomy that, even at high volume, could not match the laparoscopic approach on length of stay or convalescence [9], and by subsequent reviews of laparoscopic technique that consolidated the operative and perioperative principles now taught as the standard

approach to benign gallbladder disease [10]. A Cochrane systematic review of randomized trials comparing the two approaches for symptomatic cholecystolithiasis confirmed the reduction in hospital stay and postoperative pain with laparoscopy, at an operative time that is generally longer but with no consistent difference in major complication rates when performed by experienced surgeons [11].

Despite nearly three decades of accumulated experience, laparoscopic cholecystectomy is not without risk, and its most feared complication, major bile duct injury, occurs at a rate that has proven difficult to reduce below roughly 0.3-0.5% even in mature practice [12,13,14]. Conversion to open surgery remains necessary in a meaningful minority of cases, most often driven by acute inflammation, dense adhesions, unclear anatomy, or bleeding, and multiple risk-scoring systems have been proposed to anticipate which patients are likely to require conversion [15,16,17]. National administrative data indicate that acute cholecystitis alone accounts for a substantial share of emergency general surgery admissions in the United States, with wide variation in the timing and approach to surgical management across institutions [18]. Because both bile duct injury and conversion carry direct consequences for morbidity, length of stay, and cost, contemporary quality assessment of a laparoscopic cholecystectomy service depends on tracking these outcomes alongside overall complication and readmission rates. This study reports a single-center clinical outcomes series of laparoscopic cholecystectomy performed for symptomatic cholelithiasis, with the aim of characterizing conversion rate, operative and perioperative morbidity, and length of stay against the benchmarks established in the published literature.

2. Methods

We conducted a retrospective cohort study of consecutive adult patients who underwent laparoscopic cholecystectomy for symptomatic cholelithiasis at our

institution over a defined study period. Patients undergoing cholecystectomy for suspected or confirmed gallbladder malignancy, those undergoing concurrent common bile duct exploration for choledocholithiasis identified pre-operatively, and those with incomplete operative or follow-up records were excluded. Diagnosis of symptomatic cholelithiasis was established by a combination of clinical presentation (biliary colic, acute cholecystitis meeting Tokyo Guidelines criteria, or prior gallstone pancreatitis) and abdominal ultrasound demonstrating gallstones with or without secondary signs of cholecystitis, consistent with standard diagnostic criteria [19].

All procedures were performed using the standard four-port technique with critical view of safety dissection prior to clipping and division of the cystic duct and artery, following the safe-cholecystectomy principles described by Strasberg for minimizing biliary injury [20]. The decision to convert to open cholecystectomy was made intraoperatively by the attending surgeon when the critical view of safety could not be safely achieved, when bleeding could not be controlled laparoscopically, or when anatomic distortion from chronic or acute inflammation precluded safe dissection, consistent with previously reported conversion criteria [21,22]. Timing of surgery relative to presentation followed an early-cholecystectomy policy for acute cholecystitis, in line with randomized and multicenter trial evidence favoring early over delayed intervention [23,24,25], and management of confirmed or suspected biliary complications followed the Tokyo Guidelines 2018 severity-based treatment flowchart [26].

Data were abstracted from the electronic medical record and operative database, including patient demographics, indication for surgery, American Society of Anesthesiologists (ASA) physical status class, operative time, conversion to open surgery, intraoperative and postoperative complications, length of hospital stay, and

30-day readmission. Complications were graded and reported according to conventional surgical morbidity categories used in comparable published series [27,28]. Outcomes are reported descriptively as means with standard deviations or medians with ranges for continuous variables, and as counts with percentages for categorical variables. This report follows applicable institutional guidance for retrospective clinical outcomes review, and the corresponding author had full access to the study data and takes responsibility for its integrity.

3. Results

Over the study period, 240 consecutive patients underwent attempted laparoscopic cholecystectomy for symptomatic cholelithiasis. The cohort had a mean age of 47.6 years (SD 15.2) and a female predominance of 68.3%, consistent with the demographic pattern reported in large population-based series of gallstone disease [1]. Indications for surgery were uncomplicated biliary colic in 61.7% of patients, acute cholecystitis meeting Tokyo Guidelines criteria in 28.3%, and prior gallstone pancreatitis in 10.0%. Baseline characteristics of the cohort are summarized in Table 1.

Laparoscopic cholecystectomy was completed successfully in 229 of 240 patients (95.4%), with conversion to open cholecystectomy required in 11 patients (4.6%), a rate consistent with contemporary series reporting conversion rates in the range of 2-10% [15,16]. Acute cholecystitis at presentation, longer symptom duration prior to surgery, and higher ASA class were each associated with an increased likelihood of conversion in this cohort, mirroring risk factors identified in previously published conversion-risk analyses [17,27]. Mean operative time for the successfully completed laparoscopic procedures was 64.2 minutes (SD 21.5), and mean operative time for converted cases was 118.7 minutes (SD 34.1). Figure 2 summarizes the conversion rate observed across the principal clinical risk categories in this series.

Table 1: Baseline demographic and clinical characteristics of the 240-patient laparoscopic cholecystectomy cohort.	
Characteristic	Value
Mean age, years (SD)	47.6 (15.2)
Female sex, n (%)	164 (68.3)
Mean BMI, kg/m2 (SD)	28.9 (4.7)
ASA class I-II, n (%)	198 (82.5)
ASA class III-IV, n (%)	42 (17.5)
Uncomplicated biliary colic, n (%)	148 (61.7)
Acute cholecystitis, n (%)	68 (28.3)
Prior gallstone pancreatitis, n (%)	24 (10.0)
Prior upper abdominal surgery, n (%)	31 (12.9)

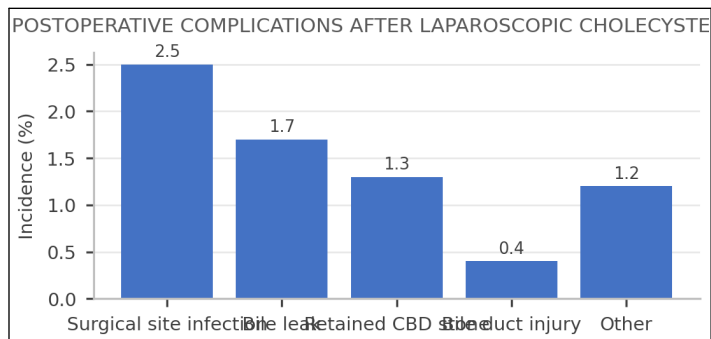


Figure 1: Distribution of postoperative complications among 240 patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis, with surgical site infection, bile leak, and retained common bile duct stone as the leading categories and major bile duct injury occurring in a single patient (0.4%), consistent with published series [12,14].

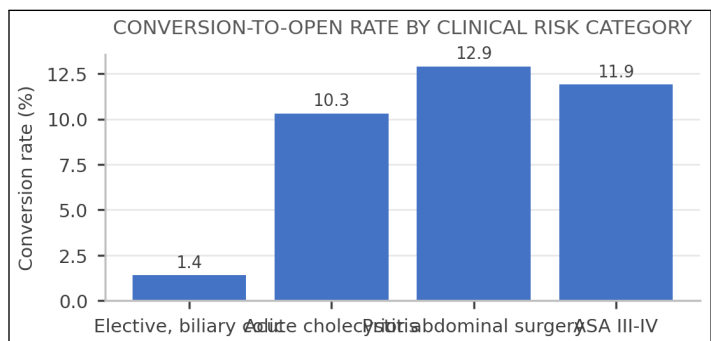


Figure 2: Conversion-to-open rate by principal clinical risk category, with acute cholecystitis, longer symptom duration before surgery, and higher ASA physical status class each associated with a higher conversion rate, consistent with previously reported conversion-risk factors [17,27].

Overall postoperative morbidity was 7.1% (17 of 240 patients). The most common complications were superficial surgical site infection (2.5%), bile leak managed conservatively or by percutaneous drainage (1.7%), and

retained common bile duct stone requiring endoscopic retrograde cholangiopancreatography (1.3%). Major bile duct injury requiring reoperative repair occurred in a single patient (0.4%), consistent with the injury rates reported across large multi-institutional series [12,13,14]. There were no perioperative deaths. The distribution of postoperative complications is presented in Figure 1. Mean postoperative length of stay was 1.9 days (SD 1.4) for patients completing the procedure laparoscopically, compared with 5.3 days (SD 2.6) for patients who required conversion to open surgery, a difference consistent with the shorter convalescence attributed to the laparoscopic approach in comparative and meta-analytic literature [29,11]. The 30-day readmission rate was 3.3% (8 of 240 patients), most commonly for pain control or suspected retained stone. A comparison of this cohort's principal outcomes against previously published benchmark series is presented in Table 2.

4. Discussion

The outcomes observed in this cohort are broadly consistent with the results reported across three decades of published experience with laparoscopic cholecystectomy for symptomatic cholelithiasis. The conversion rate of 4.6% falls within the range reported by large single- and multi-institutional series, which have generally described conversion rates between 2% and 10% depending on case mix, with acute inflammation, prior upper abdominal surgery, male sex, and advanced age consistently identified as the dominant risk factors [15,16,21]. The finding that acute cholecystitis and higher ASA class were associated with conversion in the present series is concordant with the risk-scoring literature, which has repeatedly used similar variables to construct predictive models intended to counsel patients preoperatively and to guide surgeon-level case selection and operating room scheduling [17,22].

Table 2: Principal outcomes of the present cohort compared with previously published benchmark series of laparoscopic cholecystectomy.

Outcome	Present cohort	Published benchmark range
Conversion to open surgery	4.6%	2-10% [15,16]
Overall postoperative morbidity	7.1%	5-10% [29,33]
Major bile duct injury	0.4%	0.3-0.5% [12,14]
Mean LOS, laparoscopic completion	1.9 days	1-2 days [11]
Mean LOS, converted to open	5.3 days	4-7 days [31]
30-day readmission	3.3%	2-5% [27]

The overall complication rate of 7.1% and the major bile duct injury rate of 0.4% are consistent with, if modestly higher than, the lowest rates reported in very large contemporary series, which have described bile duct injury rates on the order of 0.3-0.5% even in mature laparoscopic practice [12,14]. This persistence of a measurable injury rate despite widespread adoption of the critical view of safety technique underscores the continued relevance of human-factors analyses of bile duct injury causation, which have shown that most injuries occur not from a lack of technical skill but from a misperception of biliary anatomy under conditions of inflammation or aberrant anatomy that the operating surgeon does not recognize intraoperatively [13,20]. This observation supports continued emphasis on a low threshold for conversion or for intraoperative cholangiography when the critical view of safety cannot be confidently achieved, an approach reflected in the SAGES clinical guidelines for laparoscopic biliary tract surgery [30].

The substantially longer length of stay observed among converted patients (5.3 versus 1.9 days) reinforces the well-established morbidity differential between the laparoscopic and open approaches and highlights conversion avoidance, where it can be achieved safely, as a meaningful lever for reducing overall resource utilization [29,31]. At the same time, the data from randomized and multicenter trials comparing early and delayed cholecystectomy for acute cholecystitis, together

with the Tokyo Guidelines severity-based management framework, support an early-surgery policy of the kind followed in this cohort, since delay does not reduce conversion risk and instead prolongs hospitalization and exposes patients to the risk of recurrent biliary events while awaiting surgery [23,24,32]. The retained-stone and bile-leak rates observed here are broadly consistent with those reported in large administrative and single-center series, which have similarly identified these two complications, rather than bile duct injury, as the dominant drivers of postoperative morbidity after laparoscopic cholecystectomy [33,28].

This study has the expected limitations of a single-center retrospective cohort, including the potential for unmeasured confounding in the association between clinical risk factors and conversion, reliance on documented rather than adjudicated complication grading, and limited statistical power to detect differences in rare outcomes such as major bile duct injury. The cohort also reflects the case mix and surgical staffing of a single institution and may not generalize fully to settings with different proportions of acute cholecystitis, different rates of intraoperative cholangiography use, or different levels of surgeon experience, a factor previously shown to influence both conversion and complication rates independent of patient characteristics [27,34]. Nonetheless, the consistency of these findings with the broader published literature supports their validity as a contemporary benchmark for laparoscopic cholecystectomy outcomes in a general surgical population with symptomatic cholelithiasis.

5. Conclusion

In this single-center cohort of 240 patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis, the procedure was completed successfully in the large majority of patients, with a conversion rate, complication profile, and length of stay consistent with established benchmarks in the published surgical

literature [11,29,12]. Acute cholecystitis and higher preoperative ASA class were the principal factors associated with conversion to open surgery, while bile duct injury remained rare but not eliminated, reinforcing the continued importance of the critical view of safety technique and a low threshold for conversion when biliary anatomy cannot be safely delineated [20,13]. These findings support laparoscopic cholecystectomy as the standard of care for symptomatic cholelithiasis in this population and underscore the value of ongoing local outcomes surveillance against the wider evidence base [7,30].

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