



Original Research

Three Decades of Laparoscopic Cholecystectomy: Standardized Protocols and Surgical Outcomes

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Abstract

Objectives: The primary aim of this study was to present our 30 years of experience with laparoscopic cholecystectomy (LC) procedures conducted in tertiary care institutions, focusing on patient outcomes, complications, and the efficacy of standardized management protocols.

Methods: This retrospective cohort study analyzed 4,572 LC procedures conducted over a 30-year period in a tertiary medical center. All patients were managed according to a standardized protocol encompassing preoperative, intraoperative, and postoperative care, which was regularly reviewed and updated. Data on demographic characteristics, surgical indications, complications, and patient outcomes were collected and analyzed.

Results: A total of 4,572 patients (3,246 female [71%], 1,326 male [29%]) underwent LC, with a mean age of 41.0 ± 1.3 years (range 14–91). The most common indication for surgery was symptomatic or complicated gallstones, observed in 4,453 patients (97.4%). Of these, 1,966 patients (43%) had gallstone-related complications, including cholecystitis (985 patients [21.5%]), choledocholithiasis (736 patients [16.1%]), and biliary pancreatitis (247 patients [5.4%]). Simultaneous laparoscopic procedures were performed in 342 patients (7.5%), with common surgical interventions such as choledochal exploration (104 patients [2.3%]), hysterectomy (71 patients [1.5%]), and umbilical hernia repair (45 patients [1.0%]). Perioperative morbidity occurred in 361 patients (7.9%), with no reported mortality. According to the Clavien-Dindo classification, 349 patients (96.7%) experienced minor complications (grades I and II), while 12 patients (3.3%) had major complications (grades III and IV), including biliary injury (3 patients [0.07%]), intestinal injury (3 patients [0.07%]), bleeding (3 patients [0.07%]), thromboembolism (2 patients [0.05%]), myocardial infarction (1 patient [0.02%]), and pneumonia (1 patient [0.02%]). Conversion to open surgery was required in 3 patients (0.07%).

Conclusion: The adherence to a unified management protocol for LC, with periodic reviews and updates, significantly reduces postoperative mortality and the incidence of major complications, including biliary injury. Furthermore, this approach enables the safe performance of simultaneous laparoscopic procedures in patients with comorbidities, contributing to improved surgical outcomes in tertiary care settings.

Keywords: Biliary injury, conversion to open surgery, laparoscopic cholecystectomy, surgical outcomes, standardized protocols, perioperative morbidity, simultaneous laparoscopic procedures

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At the beginning of the 21st century, numerous innovations and advancements have profoundly transformed the field of surgery. These include the introduction of minimally invasive surgery, development of high-resolution im-

aging technologies, advancements in medical soundness, establishment of specialized training programs, and adoption of multidisciplinary approaches. These innovations have collectively reshaped surgical practice, enhanced pre-

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cision, reduced patient recovery times, and improved overall surgical outcomes.

The revolution in laparoscopic surgery began 40 years ago with the introduction of LC, which quickly gained recognition and became the "treatment of choice for patients with symptomatic cholelithiasis" according to the National Institutes of Health (NIH). Despite the absence of empirical or randomized trials, LC has become widely accepted. The safety of the procedure, along with its potential to reduce antibiotic usage and improve outcomes, particularly in cases of acute cholecystitis, has further facilitated its adoption. The introduction of enhanced recovery after surgery (ERAS) protocols also plays a pivotal role in promoting LC as the standard of care among surgeons.

Purpose

The primary aim of this study was to share our 30 years of experience with laparoscopic cholecystectomy performed in tertiary care institutions, highlighting the outcomes, challenges, and evolving techniques associated with this procedure over the past three decades.

Methods

This study encompasses the outcomes of laparoscopic cholecystectomy (LC) procedures performed and documented by the authors over several years. The operations were conducted at multiple institutions, including Van Yuzuncu Yil University (1996-1998), Emergency Hospital (1999), Central Clinic Hospital (2001-2008), Buraydah Central Hospital (2002-2003), Eurasia Clinic, Central Customs Hospital (2009-2015), Azerbaijan Medical University Educational Surgical Clinic (2014-2024), and the Main Military Medical Department of the State Security Service (2017-2024).

Preoperative, intraoperative, and postoperative management was standardized according to a unified protocol developed by the authors. These guidelines, formulated as comprehensive working articles, have been published in several books.^[1-5] The author directly supervised adherence to these protocols, and any deviations or complications noted during patient examinations and treatments were thoroughly discussed during regular audit meetings.

Preoperative Examinations

Standard preoperative assessments were performed for all patients diagnosed with gallstone disease. These evaluations included a thorough clinical assessment, along with laboratory tests, such as hemogram, ALT, AST, GGT, ALP, bilirubin, INR, CRP, HBsAg, anti-HCV, and abdominal ultrasound. Since 2017, liver and spleen elastography have been incorporated into routine preoperative examination protocols. Additionally, MRI and MR cholangiography were

performed to assess the bile ducts in patients presenting with elevated liver enzyme levels or signs of cholestasis. In cases where elastography readings were elevated (≥ 7 kPa), comprehensive liver evaluations were conducted to assess liver function and potential fibrosis.

Early laparoscopic cholecystectomy is prioritized in patients with acute cholecystitis. Patients who presented in the morning were typically scheduled for surgery on the same day, whereas those who arrived in the evening were scheduled for surgery the following day. In cases of complicated acute cholecystitis, such as perforation, empyema, or emphysematous cholecystitis, surgery was performed within the first 6-8 hours of hospital admission. Patients with uncomplicated acute cholecystitis underwent surgery within 12-24 hours.

In cases of choledocholithiasis and cholangitis, the approach to surgery is determined by the timing of diagnosis, the clinic's available resources, and patient preferences. For choledocholithiasis that was identified postoperatively, ERCP was performed to remove the stones. In cases of choledocholithiasis diagnosed before or during surgery, one of the two approaches was selected based on technical feasibility and patient preferences. If choledochoscopy and intraoperative cholangiography were available, one-stage laparoscopic cholecystectomy, choledochal exploration, and stone removal were performed. If the stones were extracted transcystically, the procedure was completed by clipping the cystic duct. In cases in which choledochotomy was necessary for stone removal, a T-drain was placed in the choledochus. If stone removal from the choledochus was not possible intraoperatively, choledochal drainage was performed and postoperative ERCP was scheduled. For facilities lacking the ability to perform choledochoscopy or cholangiography, a two-stage approach was used. ERCP was performed first to remove stones from the choledochus, followed by laparoscopic cholecystectomy 1-2 days later, with routine intraoperative cholangiography to confirm duct clearance.^[5]

In cases of acute biliary pancreatitis, the timing of cholecystectomy depended on the severity of the condition. For mild to moderate pancreatitis, laparoscopic cholecystectomy was generally performed during the initial hospitalization (within 5 to 14 days). For severe pancreatitis, cholecystectomy was planned once the complications of pancreatitis had been resolved.

Surgical Technique

Our surgical technique for laparoscopic cholecystectomy (LC) has remained largely unchanged over the past 30 years. The procedure begins with a thorough dissection

of Calot's triangle and the proximal third of the gallbladder, exposing the cystic duct and gallbladder artery. Two "windows" are opened to facilitate this dissection, with the artery being clamped, and cut first, followed by the cystic duct. The gallbladder is then carefully separated from the bed and removed. During the first decade of our experience, scissors and clamps were used for dissection, while in the last 20 years, hooks have been employed to enhance precision and minimize trauma.

Intraoperative cholangiography was performed as needed, primarily in cases where choledochal stones had been removed via ERCP prior to surgery, in cases of cholestasis with abnormal liver tests but no identifiable pathology on MRI, and in surgeries where enlargement or abnormalities of the choledochus were suspected during the operation.^[6]

In cases where gallbladder cancer was suspected, a biopsy or resection of the gallbladder bed and portal lymphadenectomy was performed.

Liver biopsy was also performed during surgery in patients with fatty liver, cirrhotic changes, or a history of HBV and HCV infections.

In cases of cholecystoduodenal fistula, the fistula tract was surgically closed.

Bile duct injuries were either drained or reconstructed.

Mirizzi syndrome type I, a cholecystectomy, transcystic stone removal, and drainage were performed. In cases of Mirizzi syndrome type II, a partial cholecystectomy with T-drainage was performed laparoscopically.^[7]

Perioperative Management

Perioperative management adhered to Enhanced Recovery After Surgery (ERAS) guidelines. A single dose of prophylactic antibiotics was administered during anesthesia, with a second dose administered within 24-48 hours in cases of destructive cholecystitis. To prevent thrombosis, all patients were fitted with elastic stockings, mobilized early postoperatively, and high-risk patients received anticoagulants. Crystalloid solutions were infused during surgery to maintain adequate fluid balance, with a positive fluid balance of approximately 500-1000 ml maintained at the end of the procedure.

In the early postoperative period (6-8 hours after surgery), emphasis was placed on early feeding, mobilization, and minimal use of analgesics. Most patients were discharged within 24 hours, with follow-up appointments scheduled at 1 week, and at 1, 3, 6, and 12 months postoperatively.

Statistical Analysis

All data were collected and analyzed using Microsoft Excel. Quantitative data are presented in the tables.

Results

A total of 4,572 patients who underwent laparoscopic cholecystectomy (LC) were included in the study. The mean age of the patients was 41.0 ± 1.3 years, with the age range spanning from 14 to 91 years. Among the study population, 3,246 (71%) were female, and 1,326 (29%) were male, resulting in a male-to-female ratio of 1:2.4 (see Table 1). The primary indication for surgery in 4,453 (97.4%) patients was symptomatic and complicated gallstone disease (see Table 2).

Gallstone complications were identified in 1,966 (43%) of the patients undergoing laparoscopic cholecystectomy (LC). Among these, acute cholecystitis was found in 985 (21.5%) patients, choledocholithiasis in 736 (16.1%), and biliary pancreatitis in 247 (5.4%). Additionally, asymptomatic gallstones larger than 2 cm, discovered in 34 (0.74%) patients with haemolytic anaemia, were also an indication for surgery.

Although complete cholecystectomy was performed in the vast majority of patients, exceptions were made in 11 cases (0.24%). Among these, 2 patients (0.04%) had cirrhosis, 2 patients (0.04%) had acute cholecystitis, and 7 patients (0.15%) underwent partial cholecystectomy due to Mirizzi syndrome. Furthermore, 342 patients (7.5%) with concomitant surgical pathologies underwent simultaneous laparoscopic procedures. These included 104 patients (2.27%) who underwent choledochal exploration, 71 patients (1.5%) who underwent hysterectomy, and 45 patients (0.98%) who underwent umbilical hernia repair (see Table 3).

Table 1. General Demographics of Patients

Indicator	n	%
Total count	4,572	
Average age	41.0	
Female	3,246	71
Male	1,326	29

Table 2. Indications for Laparoscopic Cholecystectomy

Indicator	n	%
Biliary colic (chronic cholecystitis)	2,599	56.85
Acute calculous cholecystitis	985	21.54
Acute cholecystitis without stones	101	2.21
Asymptomatic gallstones	34	0.74
Gallbladder polyp	106	2.32
Gallbladder cancer	11	0.24
Other complications of gallstones	1,013	22.16
Biliary pancreatitis	247	5.40
Choledocholithiasis	736	16.10
Cholecystio-enteric fistula	4	0.09
Mirizzi syndrome	26	0.57

Table 3. Simultaneous Surgical Operations Performed Laparoscopically

Indicator	n	%
Simultaneous surgeries	342	7.48
Choledochus exploration	104	2.27
Fundoplication	36	0.79
Groin hernia	19	0.42
Umbilical hernia	45	0.98
Postoperative hernia	33	0.72
Hysterectomy	71	1.55
Ovarian cystectomy	24	0.52
Bariatric surgery	7	0.15
Colonic resections	6	0.13
Liver cystectomies	11	0.24
Liver resections	7	0.15
Stomach resections	5	0.11
Pancreatic resections	3	0.07
Splenectomy	4	0.09
Small intestine resection	1	0.02
Nephrectomy	3	0.07

Perioperative Outcomes

Perioperative complication was observed in 361 (7.9%) patients, with no mortality. According to the Clavien-Dindo classification, 349 (96.7%) of these patients had minor (grade I and II) complications, and 12 (3.3%) had grade III and IV complications: biliary injury in 3 (0.7%), intestinal injuries in 3 (0.07%), bleeding in 3 (0.07%), thromboembolism in 2 (0.05%), myocardial infarction 1(0.02%) and pneumonia 1(0.02%) patient (see Table 4). In the first patient with biliary injury, ligation of the right posterior sectoral duct was performed, and the patient was monitored postoperatively. In the second patient, cystic duct leakage was observed, and 1 day after the operation, a relaparoscopy was performed, during which a transcystic catheter was inserted into the duct. The third patient suffered a lateral choledochal injury, and a T-drain was placed. Bleeding was managed by conversion to open surgery in 2 patients and by relaparoscopy in another. Intestinal injuries occurred in patients during surgery due to trocar insertion, and laparoscopic sutures were applied. Thus, conversion to open surgery was required in 3 (0.07%) patients.

Discussion

In this article, we present the results of our 30-year experience with laparoscopic cholecystectomy (LC) performed in tertiary care institutions, encompassing 4,572 patients. According to our findings, complicated gallstone disease was present in 43% of cases, simultaneous surgeries were per-

Table 4. Perioperative complications

Indicator	n	%
Perioperative complications	361	7.90
Clavien-Dindo I-II	349	7.63
Clavien-Dindo III	8	0.17
Clavien-Dindo IV	4	0.09
Biliary injury	3	0.07
Intestinal damage	3	0.07
Bleeding	3	0.07
Wound infection	145	3.17
Hernia	105	2.30
Deep vein thrombosis (DVT)	4	0.09
Pulmonary thromboembolism	2	0.04
Conservative treatment	96	2.10
Mortality	0	0.00
Conversion to open surgery	3	0.07
Relaparoscopy	2	0.04

formed in 7.5%, and perioperative complications occurred in 7.9%. Importantly, no mortality was reported.

A study by Wong et al., which included 21,706 surgical patients from 57 countries, investigated complications and mortality rates following cholecystectomy for gallbladder pathologies. The 30-day complication rate was 8%, and the mortality rate was 0.4%. These findings are consistent with the general complication rate observed in our experience, although significant differences were observed in the types of complications. In our study, major complications occurred in 3.3% of cases, while major complications accounted for 30% in the Wong study.^[8] Additionally, biliary injuries were rarely reported in our experience (0.07%).

Simultaneous surgeries accounted for 7.5% in our experience. The literature shows variability in this figure. For instance, Kadir Y. and colleagues retrospectively analyzed the outcomes of cholecystectomy performed concurrently with bariatric surgery, involving 396 patients. Of these, 72 patients (18.1%) underwent simultaneous laparoscopic surgery.^[9]

In our study, choledochal exploration was performed in 104 patients (2.27%). A multicenter study reported a higher rate of 3.5% for choledochal exploration.^[10]

A 13-year study reported a mortality rate of 0% and a morbidity rate of 5.08%, with complications primarily due to damage to the bile tree and gallbladder artery.^[10] In another study, the mortality rate was found to be 0.24%.^[11]

According to the results of our experience, the mortality rate is zero, major complications, including biliary injuries, are low, and the rate of simultaneous operations is relatively high.

It is widely recognized that the organization and management of clinical protocols encompassing the development, adherence, monitoring, and periodic evaluation of perioperative and operative guidelines play a critical role in shaping surgical outcomes. We believe that one of the key factors contributing to the favorable results observed in our laparoscopic cholecystectomy experience is the rigorous adherence to preoperative and postoperative protocols, the use of safe surgical techniques, and the implementation of regular audits and quality control measures.

Conclusion

In conclusion, we emphasize that the systematic organization, implementation, and continuous monitoring of a standardized protocol for preoperative, intraoperative, and postoperative management is essential to minimize mortality, reduce the incidence of major complications, including biliary injuries, and improve the success rate of simultaneous operations in laparoscopic cholecystectomy.

Disclosures

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Ethics Committee Approval: All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Authorship Contributions: Concept – N.B.; Design – I.A.; Supervision – N.B.; Materials – N.B.; Data collection &/or processing – N.B., A.I.; Analysis and/or interpretation – N.B., A.I.; Literature search – A.I.; Writing – N.B., A.I.; Critical review – N.B.

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