# A comparison of incidents and complications among patients who underwent laparoscopic vs open cholecystectomy

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## ABSTRACT

**Introduction:** Cholecystectomy, the surgical removal of the gallbladder, is common for gallstone disease. Laparoscopic cholecystectomy (LC) is favoured for its benefits over open cholecystectomy (OC). This study compares incidents and complications between the two approaches at the Surgical Professorial Unit, Teaching Hospital Karapitiya.

**Methods:** A comparative cross-sectional study evaluated incidents and complications in LC versus OC patients from 2015 to 2023. Altogether 302 patients were sampled, meeting specific criteria, with data collected retrospectively and analysed statistically.

**Results:** Of the 302 patients, 70.5% (n=213) had LC and 29.5% (n=89) had OC. Haemorrhage was common in OC (3.6% vs. 2.6%), while gallbladder perforation occurred more in LC (7.3% vs. 0.7%). Challenges in identifying Calot's triangle were more frequent in LC (4.3% vs. 0.3%). Postoperatively, LC patients had shorter hospital stays (1.32 vs. 3.52 median days). Cardiac complications were common, while surgical site infections were more prevalent in OC. (2.3% vs 0.9%). Presence of comorbidities like diabetes ($p$=0.04) and ischaemic heart disease ($p$=0.037) correlated with postoperative complications significantly. Mortality rates were higher in OC (2.2% vs. 0.4%). Conversion to OC from LC was zero.

**Conclusions**: LC is preferred method for cholecystitis due to its advantages over OC, including shorter hospital stays, and fewer complications. Higher efficacy of LC in managing comorbidities and its safety, with no conversions to OC, supports its recommendation as the treatment of choice for cholecystitis patients, particularly those with underlying health conditions.

**Keywords:** *Cholecystectomy, Complications, Comorbidities, Laparoscopic cholecystectomy (LC), Open cholecystectomy (OC).*

## Introduction

Cholecystectomy, the surgical removal of the gallbladder, is one of the most commonly performed procedures worldwide and is primarily indicated for the treatment of symptomatic gallstones and their associated complications.

The prevalence of gallstones in the Western adult population is estimated to be around 10% to 15%, while among African and Asian populations the prevalence is around 3% to 5%. There are 3 main types of gallstones; which are cholesterol stones accounting for 80-90%, brown pigment stones and black pigment stones (1, 2).

While the majority of the patients with gallstones are asymptomatic, around 1% to 4% of the individuals, develop symptomatic gallstone disease annually. Once symptomatic they may continue to develop complications of gallstone disease at a rate of 0.1% to 0.3% annually. One of the most common presentations of symptomatic gallstone disease is biliary colic and it presents with intermittent severe colicky abdominal pain in the right upper quadrant or the right hypochondrial region of the abdomen. Another common presentation of gallstone disease is acute cholecystitis, and in this patient will develop fever as well as persistent pain in the right upper quadrant with tenderness on palpation over the gallbladder, which is known as the Murphy's sign (2, 3).

Other less common complications of gallstone disease are Mirizzi syndrome, mucocele, and choledocholithiasis. Dreaded complications such as empyema of the gallbladder, which is caused by pus accumulation, acute cholangitis caused by gallstones obstructing at the level of common bile duct leading to colonization and overgrowth of bacteria in static bile, carcinoma of gallbladder and gallbladder perforation leading to intestinal obstruction are also occasional causes of presentation among patients with gallstone disease (2).

Complications in cholecystectomy can be divided into intraoperative and postoperative incidents. Some of the common intraoperative incidents are iatrogenic perforation of the gallbladder, bleeding from cystic artery or tissue adjacent to the gallbladder, injury to the common bile duct, and spillage of gallstones. The incidence of bile duct injury in open cholecystectomy (OC) only amounts to 0.2 - 0.3% while in laparoscopic cholecystectomy (LC) it has been found that the incidence is around 0.4 - 1.5%. However, the most common intra-operative complication during LC is perforation of the gallbladder with spilled gallstones which has an incidence of around 20 - 30% (4, 5). In case of these complications during laparoscopic surgery, conversion to open surgery may be considered.

Bile duct injury leading to bile leak can be identified during the immediate postoperative period rather than during the surgery and they will present with abdominal pain, bile in the drain inserted, jaundice and recurrent fever. Apart from this undrained bile may cause sub hepatic collection and lead to biloma formation, which is an encapsulated collection of bile outside the biliary tree within the abdominal cavity. Retained calculi in the common bile duct is also another complication that is observed during the postoperative period (4, 5).

Intraabdominal haemorrhage, surgical wound infection, haematoma formation, incisional hernia, and deep vein thrombosis are other post-procedure complications commonly seen and reported in studies. From the complications, incidence of wound infection, haematoma and the formation incisional hernia, is much more common in OC than in minimally invasive laparoscopic surgery due to its larger incision (4, 6). Postoperative pain is one of the major postoperative incidents studied over the years and has been found to be one of the common complications of OC (6). Smaller incisions in laparoscopic surgery result in less postoperative pain, quick recovery, shorter hospital stay and better cosmetic outcomes (7).

Assessment of clinical outcomes associated with OC and LC is crucial for clinical practice as it is one of the major surgical procedures in our setting.

This comparative study aims to evaluate the incidents and complications following OC and LC in a tertiary care setting in southern Sri Lanka. Our study compares postoperative complications, risk factors, conversion rates to laparotomy, morbidity, and mortality between open and laparoscopic cholecystectomy. Findings aim to identify the procedure associated with lower complication rates, shorter hospital stays, reduced pain, and faster recovery. Given the financial implications of factors like operating time and hospital stay, our study will assist healthcare providers and policymakers in resource allocation and planning.

The decision to choose between OC and LC is zbased on several elements such as patient factors, the severity of gall bladder disease and surgeon expertise. Therefore, we plan to focus on the above areas which can provide evidence-based information that helps in making decisions when selecting the most appropriate and economically viable surgical technique for individual patients.

As our study population, we chose the Surgical Professorial Unit of Teaching Hospital Karapitiya because of easy approachability to patient records

and it is the only unit in Teaching Hospital Karapitiya where multiple surgeons are involved in ward management. Our goal is to contribute to enhancing the overall quality of surgical care and patient satisfaction. We hope that the study will allow to make informed decisions in a similar setting regarding surgical approaches for gallbladder pathologies, ultimately benefiting the patient outcomes.

## Methods

The study comprised 302 patients who underwent open and laparoscopic cholecystectomy at Teaching Hospital Karapitiya, Sri Lanka, from January 2015 to January 2023. Inclusion criteria included adult patients aged 20 - 70 years with complete documentation and no prior abdominal surgery or patients who have undergone a single laparotomy. Those outside this age range or who have undergone multiple laparotomies as well as those classified as ASA 3 or ASA 4 per the American Society of Anaesthesiologists Physical Status classification, indicating severe systemic disease or a constant life-threatening condition, were excluded from the study. (ASA 3: A patient with severe systemic disease. ASA 4: A patient with severe systemic disease that is a constant threat to life.)

According to non-probability convenient sampling, 89 patients who had undergone OC and 213 patients who have undergone LC were chosen, and they were retrospectively analyzed. Data were obtained from the medical records including bed head tickets of the patients and theatre registries with prior consent from the Director of THK and all the consultants of the ward. As endpoints of the study, rates of intraoperative and postoperative complications between the 2 groups mortality rates and associated factors of intraoperative incidents and postoperative complications were assessed. Ethical clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Ruhuna, Sri Lanka.

## Results

The study sample consists of 302 patients who has undergone cholecystectomy. From the total sample, 70.5% (n=213) patients have undergone LC while only 29.5% (n=89) have undergone OC. The mean age ($\pm$SD) of the sample was 53.87 (+6.62) years. Socio-demographic factors and comorbidities of the sample is shown in Table 1.

**Table 1:** Socio-demographic profile of the patient-sample

| | | Frequency (N) | Percent |
|---|---|---|---|
| **Age** | < 40 | 6 | 1.9% |
| | 40 - 49 | 69 | 22.8% |
| | 50 - 59 | 167 | 55.3% |
| | > 60 | 60 | 20.0% |
| **Gender** | Male | 37 | 12.3% |
| | Female | 265 | 87.7% |
| **Comorbidities** | Diabetes mellitus | 97 | 32.1% |
| | Dyslipidaemia | 61 | 20.2% |
| | Hypertension | 55 | 18.2% |
| | Ischaemic heart disease | 9 | 3.0% |
| **Smoking** | | 17 | 5.6% |

Most common indication for surgery was symptomatic gallstone disease accounting for 88.1% (n=266). Two patients (0.6%) patients had undergone cholecystectomy while Whipple's procedure and one (0.3%) patient had undergone cholecystectomy due to Gallbladder CA of the sample, 10.9% (n=33) patients have undergone cholecystectomy after presentation with gallstone disease and comorbidities such as diabetes mellitus.

In the sample 87.7% (n=265) were performed as elective procedures and 12.3% (n=37) were performed as hot procedures. Ten (3.3%) of the patients who have undergone LC have undergone ERCP prior to and post procedure, while 2 (0.7%) patients underwent OC.

*Intra-operative complications*

Haemorrhage was the most frequently observed complication in patients who underwent OC, occurring in 2.6% (n=8), whereas for patients undergoing LC, the most common incident was gallbladder perforation, with a reported rate of 7.3% (n=22). Thirteen cases (4.3%) of LC encountered challenges in identifying Calot's triangle during surgery. Notably, there were no reported cases of common bile duct injury during the intraoperative period. The findings are summarized in Figure 1.

*Post-operative complications*

Length of hospital stay among patients who underwent LC ranged between 1 to 12 days with a median of 1.45 days.

Length of stay among patients who underwent OC ranged between 1 to 16 days with a median of 3.52 days. The most common post-operative complication that was reported among patients who underwent cholecystectomy was cardiac complications which include myocardial infarction and arrhythmias, which was reported in 1.7% (n=5) of the patients. As for the OC group the most common complication was surgical site infection (SSI) which accounted for 2.3% (n=7). SSI was also the most commonly reported infection in the entire sample. The findings are summarised in Figure 2.

*Risk factors associated with post-operative complications*

Diabetes mellitus ($p$=0.04) and Ischaemic heart disease ($p$=0.037) were significantly associated with the development of post-operative complications in patients undergone cholecystectomy (Table 2). Development of post-operative complications among patients with dyslipidemia were higher in OC (7.87%) than in LC (2.35%). Patients with Ischaemic heart disease who underwent OC (3.37%) have a higher incidence of postoperative complications compared to those who underwent LC (0%). Patients diagnosed with diabetes mellitus who have undergone OC exhibit a greater likelihood of experiencing post-operative complications (12.36%) in contrast with those who have undergone LC (2.36%). The findings are tabulated in Table 3.

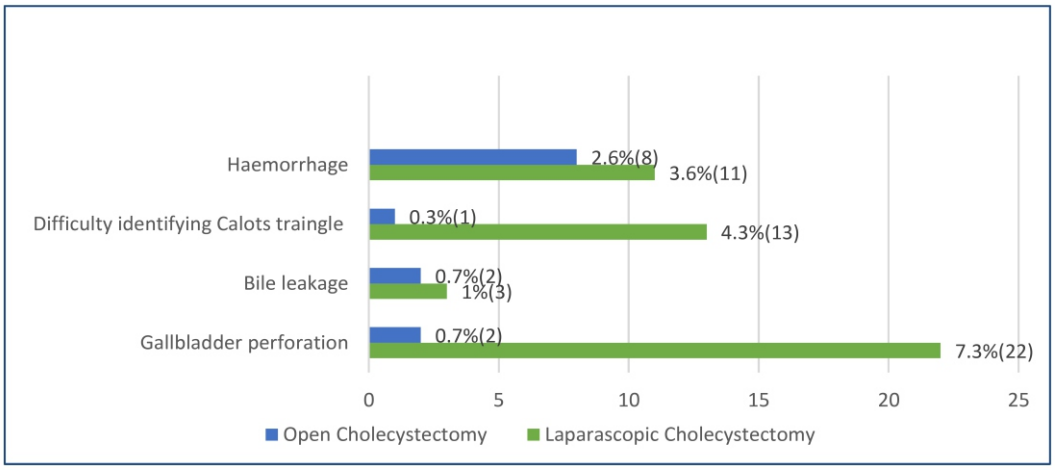


**Figure 1**: Intraoperative incidents & complications reported in open and laparoscopic procedures

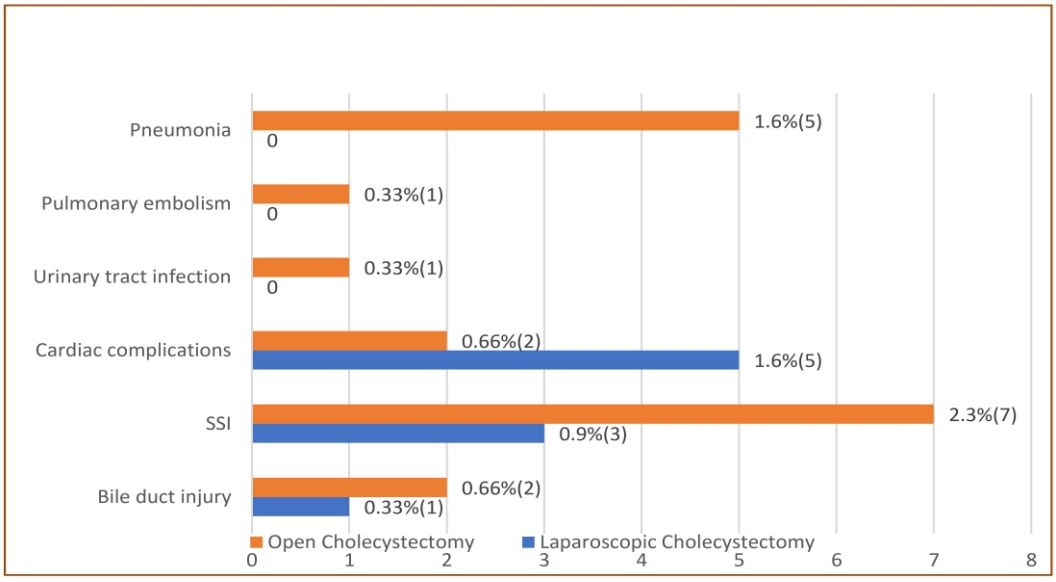


**Figure 2**: Post-operative complications reported in open and laparoscopic procedures

**Table 2:** Association between comorbidities and post-operative complications

| | | IHD | | | | |
|---|---|---|---|---|---|---|
| | | No | Yes | Total | $X^2$ | *p* |
| **Post op Complications** | No | 269 | 6 | 275 | 6.78 | 0.037 |
| | Yes | 24 | 3 | 27 | | |
| **Total** | | 293 | 9 | 302 | | |
| | | **DM** | | | | |
| | | No | Yes | Total | $X^2$ | *p* |
| **Post op Complications** | No | 194 | 81 | 275 | 10.02 | 0.04 |
| | Yes | 11 | 16 | 27 | | |
| **Total** | | 205 | 97 | 302 | | |

**Table 3:** Incidence of post-operative complications in laparoscopic vs. open cholecystectomy in the presence of co-morbidities

| | **Post op Complications with Diabetes Mellitus** | | |
|---|---|---|---|
| | No | Yes | Total |
| **Lap** | 208 | 5 (2.35%) | 213 |
| **Open** | 78 | 11 (12.36%) | 89 |
| | **Post op Complications with Ischaemic Heart Disease** | | |
| | No | Yes | Total |
| **Lap** | 213 | 0 (0%) | 213 |
| **Open** | 86 | 3 (3.37%) | 89 |

Conversion rate of laparoscopic cholecystectomy to open was zero. Mortality among open cholecystectomy was 2.2% (n=2) and among laparoscopic cholecystectomy was 0.4% (n=1).

## Discussion

The aim of our study was to compare the incidents and complications among patients who underwent laparoscopic and open cholecystectomy at the surgical professorial unit of Teaching Hospital Karapitiya.

A retrospective analysis done in Northern Sri Lanka by Sivakumaran & Srikanthan highlighted that the common indication for cholecystectomy was symptomatic gall stone disease (72.4%) (8). The results of our study showed similar findings with symptomatic gallstones (88.1%) being the most common indication for the surgery. Meanwhile 10.9% (n=33) patients have undergone cholecystectomy due to presence of gallstones and comorbidities such as diabetes mellitus together.

Williams *et al.,* in a study done to compare LC with OC showed that 01 bile duct injury during the surgery in the OC group while 03 in the LC group, but this difference was not statistically significant. This study has showed higher mortality rates (2.3% versus 0% $p$=0.03) in individuals with acute cholecystectomy who underwent open cholecystectomy (9). However, in our analysis we found no reported cases of bile duct injury during the intraoperative period. Haemorrhage was the most frequently observed intraoperative complication in patients who underwent OC (2.6% n=8) whereas in LC group most common incident was gallbladder perforation with 22 (7.3%) reported cases. The mortality among OC was 2.2% (n=2) and among LC was 0.4% (n=1).

Jatzko *et al.,* in a multivariate analysis stated the total complications rate in the OC group was 7.7% with 5 post-operative deaths, compared with that of 1.9% and 01 post-operative death in the LC group. This study also revealed that both old age ($p$=0.014) and the existence of common bile duct stones *(*$p$=0.02) had influenced in increasing overall complication rate in OC group. However, only old age*(*$p$=0.019) had influenced the overall complication rate after LC. It has also concluded during this study that the overall complication rate was influenced independently by OC when considering all cholecystectomies (10). We found 9 patients who underwent LC had post-operative complications while in OC group 18 patients had complications. In our comparative study the most common post-operative complication reported in OC group was cardiac complications, which included myocardial infarction and arrhythmias, which was in 1.7% (n=5) of the patients.

Paajanen *et al.,* found that LC is considered safe for diabetic patients with symptomatic gallstones, whereas open surgery, particularly in patients with higher ASA classification and multiple comorbidities, is linked to a higher rate of postoperative complications (11). Similarly, our research observed that diabetic patients undergoing OC are more likely to experience post-operative complications compared to those undergoing LC (12.36% versus 2.36%). Serban *et al.,* also noted that diabetes is associated with increased surgical and systemic postoperative morbidity, while suggesting a correlation between chronic renal insufficiency and a heightened risk of cardiovascular complications (12). However, our research did not find a significant association between chronic kidney disease (CKD) and post-operative complications.

Paajanen *et al.,* have revealed significant associations between various factors and heightened rates of post-operative complications (12). Specifically, type 1 diabetes mellitus, utilization of open surgical techniques, higher American Society of Anesthesiologists (ASA) classification, and a greater burden of multiple comorbidities exhibited a pronounced correlation with increased incidence of post-operative complications. Our research implicated that there was a significant association between IHD and post operative complication ($p$=0.037) but no significant associations between COPD, Hypertension, Heart failure and smoking. Among patients with IHD who developed post-operative complications following cholecystectomy were higher in open (3.37%) than in laparoscopic (0%) surgery.

The majority of studies indicate a conversion rate of 5-10%, although some have observed lower rates

ranging from 1 - 2% (13, 14). This variability is attributed to factors such as institutional differences and the proficiency of surgeons in laparoscopic techniques, with higher skill levels generally associated with lower conversion rates. Namias *et al.,* demonstrated a declining trend in experience with OC due to the increasing proficiency in laparoscopic approaches (15). Notably, our own research findings revealed a conversion rate of zero.

## Strengths and Limitations

As we have selected the sample size by a statistical calculation, it enhances the statistical power of the study and ensures the results are generalizable to the target population. Since our study was conducted in a teaching hospital, we could approach to an adequate data base as the surgical unit handles a substantial number of cholecystectomies. As the data was collected by research assistants, the reliability and quality of data is high owing to 100% literacy among them.

Some limitations were actualized when collecting data. Collection of data was interrupted as difficulty in finding the records of the readmissions to assess the post-operative complications.

## Conclusions and Recommendations

Our research findings strongly support laparoscopic cholecystectomy as the preferred treatment for both acute and chronic cholecystitis. Laparoscopic cholecystectomy offers several advantages over open cholecystectomy, reduced hospital stays, better outcomes and decreased development of post-operative complications. Importantly, our study highlights that patients with comorbidities experience fewer post-operative complications with laparoscopic cholecystectomy compared to open surgery. Additionally, our research demonstrates a remarkable conversion rate of zero from laparoscopic to open cholecystectomy, underscoring the efficacy and safety of the laparoscopic approach.

Healthcare institutions should prioritize training surgeons in laparoscopic techniques to ensure proficiency and minimize the conversion rate from laparoscopic to open cholecystectomy. Patients should be educated about the benefits of laparoscopic surgery compared to open surgery to facilitate informed decision-making and alleviate any concerns they may have. By implementing these recommendations, healthcare providers can optimize the management of cholecystitis, improve patient outcomes, and enhance healthcare resource utilization.

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