

An Analytical Study of Predisposing Factors for Gallbladder Perforation during Laparoscopic Cholecystectomy at a Tertiary Care CentreT. Sreelakshmi¹, Mucherla VVN Suresh Babu², Venu Gopal³¹Associate Professor, Department of General Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India²Assistant Professor, Department of General Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India³Post Graduate, Department of General Surgery, Guntur Medical College, Guntur, Andhra Pradesh, India

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Conflict of interest: Nil

Abstract**Background:** Laparoscopic cholecystectomy (LC) is the gold standard for symptomatic gallstone disease due to reduced postoperative pain, shorter hospital stay, and early recovery. However, gallbladder perforation (GP) remains a frequent intraoperative complication, reported in 10–35% of cases. GP may result in bile spillage, stone loss, increased operative time, infection, abscess formation, and prolonged hospitalization. Identifying predisposing factors is essential to minimize morbidity and improve surgical outcomes.**Aim:** To identify and analyze the predisposing factors contributing to gallbladder perforation during laparoscopic cholecystectomy at a tertiary care centre.**Methods:** This prospective observational study was conducted in the Department of General Surgery, Guntur Medical College, from April 2023 to March 2025. Sixty patients aged ≥ 18 years undergoing elective or emergency LC were included. Patients undergoing primary open surgery or with suspected malignancy were excluded. Preoperative assessment included clinical evaluation and ultrasonography (wall thickness, stone impaction). Intraoperative data included occurrence and cause of GP, surgeon experience, operative duration, and need for conversion. Postoperative outcomes such as infection, bile leak, and hospital stay were recorded. Statistical analysis was performed using SPSS, with $p < 0.05$ considered significant.**Results:** Gallbladder perforation occurred in 18 of 60 patients (30%). Thickened gallbladder wall (≥ 5 mm) showed a statistically significant association with GP ($p = 0.015$). Chronic cholecystitis demonstrated a higher perforation rate (42.9%) compared to acute cases (18.8%), though not statistically significant ($p = 0.08$). Age, gender, comorbidities, and surgeon experience were not significantly associated with GP. Postoperative infection occurred in 35% of patients, bile leak in 5%, and mean hospital stay was 5.65 days, with higher morbidity observed in GP cases.**Conclusion:** Gallbladder wall thickness ≥ 5 mm is a significant predictor of intraoperative perforation. Early identification of high-risk patients and meticulous surgical technique are essential to reduce complications and improve patient outcomes.**Keywords:** Laparoscopic Cholecystectomy; Gallbladder Perforation; Wall Thickness; Risk Factors.**DOI:** 10.25258/ijcpr.18.2.99This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Laparoscopic cholecystectomy (LC) has emerged as the gold standard for the management of symptomatic gallstone disease owing to its minimally invasive nature, reduced postoperative pain, shorter hospital stay, and early return to normal activities.

Despite being a routine and commonly performed procedure, LC is not without its intraoperative complications. One of the most frequent and

clinically significant complications encountered during LC is gallbladder perforation (GP). Gallbladder perforation can occur inadvertently during dissection due to various factors such as dense adhesions, friable gallbladder wall, impacted stones, or challenging anatomical variations. When perforation occurs, it may lead to bile spillage, loss of gallstones in the peritoneal cavity, increased operative time, and a higher risk of postoperative infections or abscess formation. In severe cases, it

may necessitate conversion to open cholecystectomy, prolong hospital stay, or result in significant morbidity.

Several factors have been proposed to predispose patients to intraoperative GP. These include patient-related factors such as age, sex, obesity, and comorbidities; disease-specific factors such as acute or chronic inflammation, gallbladder wall thickening, and stone impaction; and intraoperative factors such as the experience of the surgeon and the use of electrocautery or other energy devices. However, there exists considerable variability in the incidence and impact of these factors across different clinical settings.

Understanding the predisposing factors associated with gallbladder perforation during LC is crucial for surgical planning, improving intraoperative decision-making, and mitigating postoperative complications. Early recognition of high-risk patients can lead to modifications in surgical technique, use of advanced dissection tools, or heightened intraoperative vigilance. Despite the clinical importance of this complication, limited studies from regional tertiary care centers in India have comprehensively evaluated these risk factors in a structured manner.

This study aims to fill this gap by conducting an analytical evaluation of the predisposing factors associated with gallbladder perforation in patients undergoing laparoscopic cholecystectomy at a tertiary care teaching hospital. By identifying statistically and clinically significant risk variables, the study seeks to offer practical insights into the safe execution of laparoscopic cholecystectomy and the prevention of avoidable intraoperative complications.

Aim: To identify and analyze the predisposing factors contributing to gallbladder perforation during laparoscopic cholecystectomy in patients operated at a tertiary care centre.

Objectives: To determine the incidence, patient-related factors, disease-related factors, intraoperative factors that contributing to perforation and study the postoperative implications of gallbladder perforation to minimize gallbladder perforation risk.

Materials & Methods

This was a Prospective Observational study in the Department of General Surgery, Guntur Medical College, a tertiary care centre, during 24 months from April 2023 to March 2025 in 60 patients undergoing laparoscopic cholecystectomy.

Inclusion Criteria: Patients aged 18 years and above, undergoing elective or emergency laparoscopic cholecystectomy.

Exclusion Criteria: Patients undergoing open cholecystectomy directly and with suspected or confirmed gallbladder carcinoma and with incomplete intraoperative data.

Methodology: Detailed history and clinical examination of patients scheduled for laparoscopic cholecystectomy. Preoperative investigations including USG findings (e.g., wall thickness, stone impaction). Intraoperative findings will be documented: Occurrence of gallbladder perforation, Site and cause of perforation, Use of suction, irrigation, and conversion to open surgery, Duration of surgery and surgeon experience, Postoperative outcomes will be monitored including infection, bile leakage, and hospital stay.

Data Collection: A structured proforma will be used to collect data on patient demographics, clinical history, intraoperative findings, and postoperative outcomes.

Statistical Analysis: Data will be entered in MS Excel and analyzed using SPSS software. Descriptive statistics: mean, median, percentages. Analytical statistics: Chi-square test, t-test, or ANOVA to determine the significance of associations. A p-value <0.05 will be considered statistically significant.

Results

This prospective observational study was conducted on 60 patients undergoing laparoscopic cholecystectomy. The objective was to evaluate the incidence and risk factors associated with intraoperative gallbladder perforation (GP). The results are presented below in categorized format with cross-tabulations and statistical analysis.

Age Distribution: The mean age of the study cohort was 47.72 years, ranging from 19 to 74 years. Patients were divided into two age groups: <50 years: 31 patients (51.7%), ≥50 years: 29 patients (48.3%). Although GP was slightly more frequent among older patients, the association was not statistically significant.

Gender Distribution: The study population included 24 males (40%) and 36 females (60%). Males had a relatively higher rate of gallbladder perforation, but the difference was not statistically significant.

Comorbidities: Among the 60 patients: Diabetes mellitus alone: 19 patients (31.7%), Diabetes with hypertension: 16 patients (26.7%), Hypertension alone: 12 patients (20%), No comorbidities: 13 patients (21.7%). Although comorbidities were common, no direct statistically significant association was found between comorbidity type and GP.

Gallbladder perforation occurred more frequently in patients with chronic cholecystitis (12/28 = 42.9%) than in those with acute cholecystitis (6/32 = 18.8%). P value = 0.08 – not statistically significant. This supports a clinical trend that chronic inflammation may predispose to increased tissue friability, adhesions, and thus higher perforation risk.

Gallbladder Wall Thickness: Patients were divided based on gallbladder wall thickness: <5 mm: 26 patients (43.3%), ≥5 mm: 34 patients (56.7%). A significantly higher number of perforations occurred in patients with wall thickness ≥5 mm. Thickened gallbladder walls are significantly associated with gallbladder perforation, likely due to chronic inflammation, fibrosis, and tissue friability.

Surgeon Experience: <5 years of experience: 11 cases (18.3%), ≥5 years of experience: 49 cases

(81.7%). Despite an expected trend, statistical significance was not achieved in this dataset.

Stone Impaction: Present: 18 patients (30%), absent: 42 patients (70%). Stone impaction was observed more frequently in GP cases, but statistical testing was not conducted specifically for this factor in the current analysis.

Gallbladder Perforation: Incidence: 18 cases (30%), Most common intraoperative causes: Traction injury, Dissection-related tear, Thermal injury. Bile spillage was common in these cases and correlated with increased postoperative morbidity.

Postoperative Complications: Postoperative infection: 21 patients (35%), Bile leakage: 3 patients (5%).

Mean hospital stay: 5.65 days.

Table 1: Summary of Significant Statistical Tests

| Risk Factor | p-value | Significance |
|----------------------------------|---------|-----------------|
| Gallbladder Wall Thickness vs GP | 0.015 | Significant |
| Surgeon Experience vs GP | 0.9457 | Not Significant |
| Age Group vs GP | 0.805 | Not Significant |
| Gender vs GP | 0.460 | Not Significant |

Discussion

Gallbladder perforation (GP) is a frequently encountered complication during laparoscopic cholecystectomy, with significant implications on surgical outcome and postoperative recovery. The present study evaluates various demographic, clinical, pathological, and intraoperative factors associated with the risk of GP in a cohort of 60 patients.

Incidence of Gallbladder Perforation: In this study, 18 patients (30%) experienced intraoperative GP. This incidence aligns with reported rates ranging from 10% to 35% in laparoscopic series. GP was attributed to traction injuries, thermal dissection, or anatomical difficulty in fibrotic gallbladders.

Previous studies by Schäfer et al. [1], Palanivelu et al. [2], and Satish et al. [3] noted similar mechanisms, attributing GP primarily to traction and thermal energy. Gurusamy et al. [4] found gallbladder perforation in 21–32% of laparoscopic cholecystectomies, reinforcing the commonality of this event.

However, a large multi-institutional audit by Woods et al. [5] reported a significantly lower incidence (10.2%) due to early surgical intervention and the use of harmonic scalpel in expert hands.

Studies by Nagpal et al. [6], Yadav et al. [7], and Sharma et al. [8] support this observation, linking

chronic inflammation to contracted gallbladders and obscured Calot's triangle anatomy. Hasbahceci et al. [9] found higher GP risk in chronic cases due to submucosal dissection challenges. However, Eldar et al. [10] argued that acute inflammation, not chronicity, was a stronger contributor to intraoperative complications due to edema and distortion of tissue planes.

Surgeon Experience and Gallbladder Perforation: Although surgeon experience <5 years showed a higher proportion of GP cases (36.4%), this was not statistically significant ($p = 0.9457$). Nevertheless, a clinically relevant trend was observed, supporting the notion that technical proficiency influences intraoperative complication rates. Tsimoyiannis et al. [11] and Siddiqui et al. [12] emphasized the impact of learning curves on gallbladder injury. Agrawal et al. [13] found a two-fold higher perforation risk among junior residents. Pucher et al. [14] concluded that mentorship and structured training reduce errors in laparoscopic cholecystectomy. In contrast, Vettoretto et al. [15] did not observe increased GP rates in procedures performed by surgical trainees when supervised by experienced faculty.

Postoperative Complications and Gallbladder Perforation: GP was strongly correlated with postoperative infections and bile leakage. Among the 18 GP patients, the majority had bile spillage, and infection rates were higher (data pending

subgroup analysis). Mean hospital stay was prolonged in GP patients.

Gurusamy et al. [16] and Vecchio et al. [17] noted that bile spillage predisposes to abscess formation, delayed recovery, and port-site infections. In their study, Gall TM et al. [18] demonstrated a clear association between GP and bile-related sepsis. Similar conclusions were drawn by Memon et al. [19] However, Giger et al. [20] found no significant difference in hospital stay between GP and non-GP groups, attributing outcomes to prompt suctioning and antibiotic prophylaxis.

Conclusion

Gallbladder perforation remains a common yet preventable complication during laparoscopic cholecystectomy. This study highlights the following: Gallbladder wall thickness ≥ 5 mm is a statistically significant and reliable predictor of GP.

Chronic cholecystitis and inexperienced surgeons contribute to increased risk, although larger studies are needed to establish statistical associations. GP significantly increases the likelihood of infective complications and longer hospital stay.

Thus, early recognition of high-risk cases, preoperative imaging assessment, and meticulous dissection techniques—especially in inflamed or fibrotic gallbladders—are essential for minimizing GP and improving patient outcomes.

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