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Original Research Article

Incidence and comparison of patient-related and technical factors for gallbladder content spillage during laparoscopic cholecystectomy

Bhavya Wadhwani*, Munish Sharma, Gaurav Patel

Department of General Surgery, ESIC Medical College and Hospital, Basaidarapur, New Delhi, India

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***Correspondence:**
Dr. Bhavya Wadhwani,
E-mail: bhaviwadhwani786248@gmail.com

ABSTRACT

Background: Gallbladder perforation with spillage of bile or stones is frequently encountered during laparoscopic cholecystectomy. Although usually considered a minor intraoperative event, it may contribute to postoperative infectious complications. The relative contribution of patient-related and technical factors remains unclear. Aim of the study was to determine the incidence of gallbladder content spillage and evaluate the contribution of patient-related versus technical factors during laparoscopic cholecystectomy.
Methods: A prospective observational study was conducted on 120 consecutive adult patients undergoing laparoscopic cholecystectomy at ESIC Medical College and Hospital, Basaidarapur, New Delhi between March 2024 and July 2025. Demographic variables, body mass index, ultrasonographic findings, intraoperative characteristics, and operative steps were analysed. Gallbladder content spillage was defined as intraoperative perforation with release of bile, stones, pus, mucus, or sludge. Statistical analysis was performed using Chi-square or Fisher's exact test, with $p<0.05$ considered significant.
Results: Gallbladder content spillage occurred in 34 patients (28.3%). The majority were females (74.2%), and 45.8% were obese. No significant association was observed between spillage and age, gender, BMI, ultrasonographic findings, or intraoperative stone characteristics. Technical factors accounted for 67.7% of spillage events compared with 32.3% attributed to patient-related factors ($p=0.003$). Excessive traction at the gallbladder fundus and dissection from the gallbladder fossa were the most common operative steps associated with spillage.
Conclusions: Gallbladder content spillage during laparoscopic cholecystectomy occurs frequently and appears predominantly related to operative technique rather than patient characteristics. Attention to critical operative steps may reduce its incidence.

Keywords: Laparoscopic cholecystectomy, Gallbladder perforation, Bile spillage, Surgical technique, Risk factors

INTRODUCTION

Laparoscopic cholecystectomy is the standard treatment for symptomatic gallstone disease.[1,6] Despite advances in laparoscopic instrumentation and operative experience, gallbladder perforation with spillage of bile or stones continues to occur during surgery. Reported incidence varies widely depending on operative difficulty and surgeon experience.[2,4,15]

Although often regarded as inconsequential, unretrieved bile or gallstones may lead to postoperative complications such as surgical site infection, intra-abdominal abscess, adhesions, and delayed diagnostic confusion.[3,5,7]

Several patient-related factors—including obesity, inflammation, gallbladder wall thickness, and stone burden—have been implicated.[12,13] Technical aspects of surgery such as traction, dissection plane, and specimen extraction technique may also influence perforation

risk.[9,14] However, direct comparison between patient-related and technical contributors remains limited.

The present study aimed to determine the incidence of gallbladder content spillage during laparoscopic cholecystectomy and evaluate the relative influence of patient-related and technical factors. To our knowledge, few prospective studies have directly compared patient-related and technical contributors to gallbladder spillage in an Indian tertiary-care setting.

METHODS

Study design and setting

This prospective observational study was conducted in the Department of General Surgery at ESIC Medical College and Hospital, Basaidarapur, New Delhi, following approval from the Institutional Ethics Committee. Written informed consent was obtained from all patients. The study was conducted and reported in accordance with the STROBE guidelines for observational studies.

Study period

The duration of the study was from March 2024 to July 2025.

Study population

A total of 120 consecutive patients undergoing elective laparoscopic cholecystectomy were included.

Inclusion criteria

Patients undergoing laparoscopic cholecystectomy for gallstone disease were included.

Exclusion criteria

Patients with redo surgery, suspected carcinoma gallbladder, liver cirrhosis, portal hypertension, and extensive intra-abdominal adhesions were excluded.

Sample size

Sample size was calculated using previously reported spillage incidence of 20% with standard formulae described by Lemeshow et al, yielding a required sample of 120 patients.

Data collection

Data were recorded prospectively using a structured proforma including: demographics, body mass index, ultrasonographic findings, intraoperative observations, and operative steps.

Gallbladder content spillage was defined as intraoperative perforation with escape of bile, stones, pus, mucus, or sludge.

Spillage events were categorized as follows.

Technical factors

Technical factors were: dissection from gallbladder fossa, excessive fundal traction, extraction through epigastric port, and clip slippage.

Patient-related factors

Patient-related factors: distended gallbladder with multiple stones, contracted or adherent gallbladder, thick-walled gallbladder (mucocele/empyema), and short cystic duct.

Surgeries were performed by consultant surgeons with ≥5 years laparoscopic experience.

Statistical analysis

Data were entered into Microsoft Excel and analysed using statistical package for the social sciences (SPSS) version 23 (IBM Corp.). Continuous variables were expressed as mean±standard deviation or median (IQR), while categorical variables were presented as frequencies and percentages.

Normality was assessed using the Shapiro-Wilk test. Associations between categorical variables were analysed using Chi-square test or Fisher's exact test. For comparison of continuous variables, independent t-test or one-way ANOVA was used for normally distributed data, and Mann-Whitney U test or Kruskal-Wallis test for non-parametric data. Correlation between continuous variables was assessed using Pearson's or Spearman's correlation as appropriate. A p value <0.05 was considered statistically significant.

RESULTS

A total of 120 patients undergoing laparoscopic cholecystectomy were included in the study.

The age distribution showed that the majority of patients belonged to the 31–40 years age group (31.67%), followed by the 41–50 years age group (28.33%). Females constituted nearly three-fourths of the study population (74.17%), indicating a marked female predominance among patients undergoing laparoscopic cholecystectomy (Table 1).

According to BMI classification, 45.83% of patients were obese, making obesity the most common BMI category in the study population (Table 2).

Gallbladder content spillage occurred in 34 out of 120 patients, yielding an incidence of 28.33%, while the remaining 71.67% of procedures were completed without spillage (Table 3).

Table 1: Demographic characteristics of the study population (n=120).

Variable	Category	N (%)
Age (years)	18–30	21 (17.5)
	31–40	38 (31.7)
	41–50	34 (28.3)
	51–60	18 (15.0)
	>60	9 (7.5)
Sex	Female	89 (74.2)
	Male	31 (25.8)

Table 2: Body mass index distribution (Asian criteria).

BMI category (kg/m²)	N (%)
<18.5 (underweight)	16 (13.3)
18.5–24.9 (normal)	26 (21.7)
25–29.9 (overweight)	23 (19.2)
≥30 (obese)	55 (45.8)

Table 3: Incidence of gallbladder content spillage.

Spillage status	N (%)
Yes	34 (28.3)
No	86 (71.7)

Table 4: Ultrasonographic findings.

Finding	N (%)
Multiple stones	75 (62.5)
Single stone	33 (27.5)
Sludge	5 (4.2)
Others (mucocele/pyocele)	7 (5.8)

Table 5: Intraoperative findings.

Finding	N (%)
Multiple stones	74 (65.5)
Single stone	21 (18.6)
Thick-walled gallbladder	9 (8.0)
Sludge/mucocele/pyocele	6 (5.3)
Short cystic duct	3 (2.7)

Table 6: Operative steps associated with gallbladder content spillage (n=34).

Operative step	N (%)
Excessive traction at fundus	15 (44.1)
Dissection from gallbladder fossa	14 (41.2)
Extraction through epigastric port	3 (8.8)
Slippage of ligaclip	2 (5.9)

Table 7: Type of gallbladder content spilled (n=34).

Content	N (%)
Bile	19 (55.9)
Pus	5 (14.7)
Sludge	5 (14.7)
Stones	4 (11.8)
Mucus	1 (2.9)

Table 8: Factors contributing to gallbladder content spillage (n=34).

Factor type	N (%)	P value
Technical	23 (67.7)	0.003
Patient-related	11 (32.3)	

Table 9: Association between patient-related factors and gallbladder content spillage (n=120).

Variable	Category	Spillage (n=34)	No spillage (n=86)	P value
Age (years)	18–30	6	15	
	31–40	11	27	
	41–50	10	24	
	51–60	5	13	
	>60	2	7	0.782
Gender	Female	25	64	
	Male	9	22	0.921
BMI category	Underweight	5	11	
	Normal	7	19	
	Overweight	5	13	
	Obese	17	43	0.638
Ultrasonography findings	Multiple stones	22	53	
	Single stone	9	24	
	Sludge	1	4	
	Others	2	5	0.887

Values expressed as number of patients. P<0.05 considered statistically significant.

Ultrasonographic evaluation revealed multiple gallstones in 62.5% of patients, whereas single gallstones were identified in 27.5%. Other findings were comparatively less frequent, indicating that multiple stones were the predominant preoperative ultrasonographic finding (Table 4).

Similarly, intraoperative assessment demonstrated multiple gallstones in 65.5% of cases, confirming the predominance of multiple calculi observed on preoperative imaging (Table 5).

Among patients who experienced gallbladder content spillage (n=34), excessive traction at the fundus was the most common intraoperative step associated with spillage (44.12%), closely followed by dissection from the gallbladder fossa (41.18%). Other operative steps contributed less frequently (Table 6).

Analysis of the spilled contents showed that bile alone was the most commonly spilled material (55.88%), whereas stone spillage with or without bile leakage occurred less frequently (Table 7).

Technical factors were responsible for 67.65% of spillage events, while patient-related factors accounted for 32.35%. Technical factors were therefore significantly more common contributors to gallbladder content spillage than patient-related factors (p=0.0033) (Table 8).

No statistically significant association was found between gallbladder content spillage and demographic or clinical variables. The incidence of spillage did not differ significantly according to age (p=0.782), gender (p=0.921), BMI category (p=0.638), ultrasonographic findings (p=0.887), or intraoperative findings (p=0.756), suggesting that these factors were not predictors of gallbladder content spillage in the present study (Table 9).

DISCUSSION

This study demonstrated an incidence of gallbladder content spillage of 28.3% during laparoscopic cholecystectomy, consistent with previously reported literature.[4,5,15]

Patient-related parameters such as age, gender, BMI, and preoperative imaging findings did not significantly influence spillage occurrence. These findings suggest that prediction of perforation based solely on patient characteristics remains unreliable.[1,6]

In contrast, operative technique played a dominant role. Excessive traction at the fundus and dissection from the gallbladder fossa were the principal contributors. Increased tension on an inflamed gallbladder and difficulty maintaining the correct dissection plane likely explain these observations.[9,12]

Although spillage is often unavoidable, careful handling, controlled traction, and meticulous dissection may reduce its occurrence. Prompt suction, irrigation, and retrieval of spilled contents remain essential to prevent postoperative complications.[10,14,16]

The present findings emphasise that gallbladder perforation during laparoscopic cholecystectomy represents primarily a technical event and therefore a potentially modifiable factor. Future multicentric studies with larger sample size and multivariate modelling may further clarify independent predictors of gallbladder perforation.

Limitations

Limitations of the study were: single-centre study, moderate sample size, multivariate analysis not performed, and observational design limits causal inference.

CONCLUSION

Gallbladder content spillage occurred in 28.3% of laparoscopic cholecystectomies and was predominantly associated with operative technical factors rather than patient characteristics. Greater attention to critical operative steps may reduce its incidence.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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