Gallbladder Perforation During Elective Laparoscopic Cholecystectomy Incidence, Risk Factors and Outcomes

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Abstract

Objective: The goal of this study was to discover the risk factors for perforation of the gallbladder during laparoscopic cholecystectomy, as well as the outcomes.

Methods: All patients who had an elective cholecystectomy at our department had their videotapes reviewed retrospectively, and the patients were separated into two groups based on whether or not they had GP. The potential risk factors as well as the early results were investigated.

Results: 664 patients were totally examined [524 (78.9%) females, 49.7±13.4 years old] were observed, and GP (Gallbladder Perforation) occurred in 240 (36.1%) of them, usually during dissecting the gallbladder from its bed (n=197, 82.1%). In 177 (73.8%) of the cases, the GP was not documented in the surgery notes. There was no significant risk factor for GP among the studied parameters, with the exception of a preoperatively high alanine transaminase level (p=0.005), which had 14.2 % sensitivity and 7.4 % specificity in predicting GP. The two groups had comparable results; however, the GP group had a longer operation time (35.4±17.5 vs 41.4±18.7 min, p=0.000) and a higher rate of drain usage (25 % vs 45.8%, p=0.000).

Conclusion: According to the current study, GP occurs in 36.1 % of patients who have a laparoscopic elective cholecystectomy; however, it is not always reported. We were unable to identify any reliable risk factors that enhance the likelihood of GP. The use of GP lengthens the surgery and increases the likelihood of drain usage; nevertheless, the other results were found to be equivalent in patients with and without GP.

Keywords: *Alanine transaminase; gallbladder perforation; laparoscopic cholecystectomy.*

Introduction

Cholecystectomy is the second most frequent abdominal procedure in general surgical practice [1,2]. The advantages of laparoscopic cholecystectomy over traditional cholecystectomy include better aesthetic outcomes, less postoperative discomfort, a shorter hospital stay, and a quicker return to normal activities [3]. Furthermore, cholecystectomy is a risky treatment that might result in serious consequences such as bile duct damage, hemorrhage, abscess, and pancreatitis. Gallbladder perforation (GP), a frequent intraoperative complication during cholecystectomy, has been found to occur at a high rate of 10% to 33% [4]. The causes and consequences of GP have also been investigated [4-9]. Male sex, a history of acute cholecystitis or previous laparotomies, the use of a laser, an inflamed or nonvisualized gallbladder, and a difficult surgery have all been suggested as factors that enhance the risk of GP [5-7]. Furthermore, bile and stone spillage are infrequent and have been connected to a variety of major health problems [10-15].

Although GP does not affect the procedure's results, it has been suggested that lost stones following GP may induce secondary problems such as discomfort, fever, or intraabdominal abscesses since they are a possible source of infection, and bile spilling can induce chemical peritonitis [4, 10-16]. However, much of the data in the literature may be deceptive because it is primarily based on retrospective data, and it is likely that GPs were not documented in the operation documentation because GPs are often thought to be safe, with no negative implications in most cases. As a result, we set out to examine compact disc films of the procedures in order to better understand the occurrence, risk factors, and effects of GP.

Materials and Methods

The study's design and substance were approved by the Institutional Review Board. (Reference number: B104ISM4340029/1009/20). Between March 2011 and March 2015, all patients who had an elective cholecystectomy at our clinic were retrospectively evaluated. One of our department's six surgeons conducted or oversaw the surgeries, which were carried out utilizing a four-trocar approach as previously described [17]. Free bile was aspirated, the soiled regions were irrigated with physiological saline until clear, and dropped stones were collected wherever feasible in the event of GP during the surgery. In most cases, these patients were given antibiotics intravenously and orally for a week. The operating surgeon determined whether a drain should be placed and if open surgery should be performed. Patients were usually discharged from the hospital the same day, although extended stays were occasionally required.

The main goals of this study were to find out how often intraoperative GP is, what causes it, and what the effects are during elective laparoscopic surgery. The patients whose procedure was converted to open surgery were excluded from further analysis, however the reasons for the change were disclosed. The operation recordings filmed on compact discs (CD) of all the included patients were watched by an experienced surgeon who was blinded to the patients, operators, and outcomes of the surgeries. The patients were divided into two groups based on whether or not a general practitioner was present at the time of surgery (Perforation or No perforation groups). If the surgery CDs were not accessible or were faulty, the patients were ruled out. During this inspection, the degree of difficulty was determined using Cuschieri's scale, which categorizes the procedure's complexity into four levels [18]. Grade 1 refers to a simple cholecystectomy with no complications. The presence of mild peri-cholecystitis, adherences, or fatty tissue obscuring the cystic pedicle or mucocele is classified as Grade 2. Grade 3 cholecystectomies in patients with gangrenous cholecystitis, shrunken fibrotic gallbladders, extreme pericholecystitis, subhepatic abscesses, or advanced hepatic disorders such as cirrhosis or portal hypertension are defined by this scale. Because of the accompanying issue of adhesion of Hartman's pouch across the common bile duct, dissections of the cystic pedicle or the body gallbladder from the hepatic bed are difficult or impossible in some cases. Patients with a score of 4 difficulty were omitted since it leads to open surgery conversion [18].

Perforation occurred at the following times: During gallbladder traction, adhesions and bands are dissected, the Calot's triangle is dissected prior to cystic duct cutting, the Calot's triangle is dissected again after cystic duct cutting, the gallbladder is dissected from the hepatic fossa, and the gallbladder is extracted from the abdominal cavity. All patients' charts were reviewed, and computerized data was examined for the following information as risk factors for and outcomes of intraoperative GP. The presence or lack of previous hospitalization for acute cholecystitis, biliary pancreatitis, or cholangitis; demographics; BMI; the presence or lack of prior hospitalization for acute cholecystitis, biliary pancreatitis, or cholangitis; American Anesthesiological Score, laboratory findings [alanine transaminase (ALT), aspartate transaminase (AST), gamma-glutamyl transaminase (GGT), albumin, white blood cell (WBC), hemoglobin, total bilirubin, amylase]; need and evidence of MRCP and/or endoscopic retrograde cholangiography (ERCP) magnetic resonance imaging, ultrasonic findings; Previous procedures (include appendectomy, section, or gynecological); operators (employee or resident) experience; degree of difficulty in the operation stated by Cuschieri; time of surgery; drainage presence or omission; term of hospitalization; and complications and reasons of the rehospitalization, pathological results and mortality. Lastly, two investigators (EG and MH), who blinded to the information and operational CDs of the patients, examined the operation notes, and judged whether they had or had not been reported in the operation notes. Patients got a cholecystectomy interval between 6 and 8 weeks following the initial presentation during a prior hospitalization, owing to gallbladder blocks. When the operation and hospitalization time is inconvenient in our usual practice, patients are seen after surgery on day 7. Further follow-up is not given in the event of no complaints.

Statistical Analysis

SPSS 17.0 for Windows was used to analyze the data (SPSS Inc., Chicago, IL, USA). Percentages, mean and standard deviations, or median and ranges were used to present the findings. The Student's t-test and the chi-square (Pearson's or Fischer's exact) test were used to compare quantitative and qualitative variables, respectively. When an anomalous distribution of samples was verified by the Kolmogorov– Smirnov test, a Mann–Whitney U test was selected. A p value of less than 0.05 was considered significant.

Results

737 patients [575 (78.0 %) females with a mean (SD) age of 49.1±13.3 years] received an elective cholecystectomy at our department throughout the study period. However, 60 (8.1 %) of the operation CDs were unavailable or damaged, leaving 677 instances for further investigations. Due to severe adhesions (n=9, 1.3%), failure to identify anatomical structures (n=2, 0.3 %), significant bleeding (n=1, 0.1 %), and damage to the transverse colon (n=1, 0.1 %), 13 (1.9 %) required conversion to open surgery. As a result, the present data comprise 664 cases [524 (78.9%) females with a mean (SD) age of 49.7±13.4 years]. 240 (36.1%) of the 664 patients (Perforation group) had an intraoperative GP during gallbladder traction (n=15, 6.3%), adhesions and bands dissection (n=2, 0.8%), and other procedures. Calot's triangle dissection before cystic duct clipping (n=9, 3.8 %), Calot's triangle dissection after cystic duct clipping (n=6, 2.5 %), gallbladder dissection from its bed (n=197, 82.1 %), and gallbladder extraction from the abdominal cavity (n=11, 4.6%).

The remaining patients (n=424) were in the No perforation group. The GP was not included in the operation data for 177 (73.8 %) of the 240 patients.

Almost none of the examined characteristics, including patient-related elements, pre-operative laboratory or other diagnostic results, and operating characteristics, were shown to enhance intraoperative GP during elective laparoscopic cholecystectomy in this study (Table 1). Preoperative ALT level was the sole risk factor that enhanced the likelihood of GP ($p < 0.05$). Although 33 (52.4%) of the 63 individuals with high ALT levels developed GP, the sensitivity and specificity of higher ALT in predicting GP were 14.2% and 7.4%, respectively. Apart from ALP, there were no variations across the blood tests. Although several patients required MRCP or ERCP due to increased bilirubin levels or choledocholithiasis, no patients in the current research required intraoperative cholangiography, common bile duct exploration, or laparoscopic ultrasonography.

The results of the procedures were also examined. There were no statistically significant differences between the groups in terms of postoperative hospitalization time, complications, or re-hospitalizations, according to the findings (Table 2). In addition to the median (range) operation duration [32 (10-120) vs 36.5 (11-120), patients with GP had a substantially higher rate of drain usage (p less than

1.01 for both). As a result of the problems, no patients required reoperation. Pathological examinations, on the other hand, indicated gallbladder cancer in two patients (0.8 %), both in the Perforation group. Both patients required further treatments, however they were alive 5 and 9 months following the operations with no signs of tumor recurrence.

TABLE 1. The risk factors for gallbladder perforation during elective cholecystectomy

	No perforation (n=424)	Perforation (n=240)	p
Demographics			
Age	49.8±13.2	49.7±13.8	0.914
Gender			0.143
Females	342 (80.7)	182 (75.8)	
Males	82 (19.3)	58 (24.2)	
Body mass index	28.5±5.1	29.6±5.5	0.053
Previous hospitalization for	18 (4.2)	8 (3.3)	0.561
Acute cholecystitis	8 (1.9)	2 (0.8)	0.343
Biliary pancreatitis	7 (1.7)	5 (2.1)	0.764
Cholangitis	3 (0.7)	1 (0.4)	0.999
ASA score			
I	83 (20.2)	62 (26.7)	
II	262 (63.9)	129 (55.6)	0.104
III	63 (15.4)	41 (17.7)	
IV	2 (0.5)	0	
Laboratory Findings			
ALT	20 (6-548)	18 (7-671)	
	(n=408)	(n=232)	0.176
Elevated ALT	30 (7.4)	33 (14.2)	0.005
MRCP findings	(n=25)	(n=12)	
Cholelithiasis	21 (84.0)	11 (91.7)	0.999
+ Choledocholithiasis	4 (16.0)	1 (8.3)	
ERCP findings	(n=14)	(n=4)	
Sphincterotomy only	9 (64.3)	2 (50.0)	
+ stone extraction ± stent application	5 (35.7)	2 (50.0)	0.999
USG findings	n=338	n=207	
Stone	322 (95.3)	200 (96.6)	
Polyp	8 (2.4)	4 (1.9)	0.930
Sludge	7 (2.1)	3 (1.4)	

Residue gallbladder	**1 (0.3)**	**0**	
Stone size (>1 cm/ < 1cm)	153/169 (63.2/60.4)	89/111 (36.8/39.6)	0.502
Single/multiple	86/236 (62.8/61.3)	51/149 (37.2/38.7)	0.760
Previous operation/laparotomy			
Operations to gallbladder or gastroduodenal region	4 (0.9)	3 (1.3)	0.708
Regional laparotomy	5 (1.2)	5 (2.1)	0.508
Overall laparotomy	41 (9.7)	31 (12.9)	0.196
Experience of the Surgeon Staff/Resident	42 (58.3) / 382 (64.5)	30 (41.7) / 210 (35.5)	0.302
Degree of difficulty			0.136
I	321 (75.7)	165 (68.8)	
II	57 (13.4)	39 (16.3)	
III	46 (10.8)	36 (15.0)	

(Data are presented as either median [range] or mean [±standard deviation]. Information in the parentheses indicates the percentages).

*The levels of Hgb are presented separately in male and female patients; t: Data are presented according to Cuschieri's scale, which defines the complexity of the procedure in 4 grades; however, patients with grade 4 difficulties were excluded since it refers to conversion to open surgery [18].

ASA: American Society of Anesthesiology score; AST: Alanine transaminase; ALT: Aspartate transaminase; GGT: Gamma-glutamyl transaminase; WBC: White blood cell; Ilbg: Hemoglobin; MRCP: Magnetic resonance imaging cholangiography; ERCP: Endoscopic retrograde cholangiography; USG: Ultrasonography.

TABLE 2. Outcomes after gallbladder perforation

	No perforation (n=424)	Perforation (n=240)	p
Operation time (minutes)	**35.4±17.5**	**41.4±18.7**	**0.000**
Drain use	106 (25.0)	110 (45.8)	0.000
Hospitalization period (days)	1.3±1.0	1.3±0.9	0.664
Complications			
Bile drainage	0	2 (0.8)	0.130
Evisceration	0	1 (0.4)	0.361
Abscess	3 (0.7)	3 (1.3)	0.673
Cholangitis	4 (0.9)	1 (0.4)	0.659
Respiratory	2 (0.5)	0	0.538
Overall	9 (2.1)	7 (2.9)	0.522
Re-hospitalization	6 (1.4)	5 (2.1)	0.538

Discussion

Cholecystectomy is one of the most popular surgical procedures performed in the world [1]. Furthermore, GP is common during laparoscopic cholecystectomy. According to a recent assessment of 18.280 patients, the prevalence of GP is 18.3% [19]. In another study, the risk of GP was found to be 29% in 1059 successive laparoscopic cholecystectomies [20]. However, given prospective data has indicated that the frequency of GP following laparoscopic cholecystectomy can reach up to 33%, it's probable that even this higher rate isn't the true incidence of GP [9]. As a result, because most perforations may not be captured in operation records, it may be more appropriate to consider the highest reported rates in the literature.

The debate is likely sparked by the fact that some surgeons fail to include GP in their operation notes, which are used as data sources in retrospective studies. In some cases, GP with or without bile and stone spilling was not documented, according to a recent review of operational notes [21]. As a result, we feel that the GP rate provided in this study is more accurate, as the data was gathered from operation videos. As a result, our findings suggest that GP is more prevalent than previously thought, occurring in at least a third of all patients undergoing laparoscopic cholecystectomy. Furthermore, the current study found that GP is not recorded in nearly three-quarters of surgery records, most likely because most surgeons do not consider GP to be a serious complication and feel it is harmless, thus they do not mention it.

Several researches have looked at the possible causes of GP after a laparoscopic cholecystectomy. Male sex, a history of acute cholecystitis, the use of a laser, and the presence of a highly inflamed gallbladder were identified as independent variables in a multivariant logistic regression analysis and as risk factors for GP [5]. Other studies have found that age, preoperative ultrasound abnormalities such as a thicker gallbladder wall and hydrops, the existence of a prior laparotomy, the form of the stone (pigment stones), and the surgeon's experience all influence the frequency of GP [5, 7, 9, 22]. These studies, however, may be criticized for include patients who underwent both emergency and elective treatments, which are likely two different types of surgeries. As a result, individuals who had emergency cholecystectomies were not included in this research. Furthermore, patients who had conversion to open surgery were excluded since it was difficult to identify if the unfavorable effects in these circumstances were attributable to the GP or the conversion itself. As a result, the current study focuses on a more specific condition: elective non-problematic laparoscopic cholecystectomy, which is the situation in the vast majority of cases.

Although the current study found that a pre-operatively high ALT level may be a signal for a possible GP at the time of the surgery, we are not sure if this is a major factor or an accident because the risk for GP was only 52.4 % in patients with increased ALT levels, which was less than two-fold that of individuals with normal ALT levels. As a result, because the sensitivity and specificity were unacceptably low, the preoperative ALT level, in our opinion, cannot be regarded a predictor of GP. Surprisingly, no association between GP and the cholecystectomy difficulty scale was found in the current data. Although there was no change in the statistical analysis, the p value of 0.136 might indicate a trend. There was no other risk factor that we discovered that enhanced the likelihood of GP. As a result, we feel that GP in the event of an elective cholecystectomy may be unpredictable.

According to a recent study, 69 of 131 gallbladder perforations (52.7 %) died when dissecting the gall bladder from the hepatic fossa [6]. We may infer that separating the gallbladder from its bed is the most dangerous stage of cholecystectomy for a potential GP because we had the same result. This knowledge, we feel, is crucial, and it may alert surgeons to this particular concern. Furthermore, the above-mentioned principle should be stressed during surgeons' training.

The effects of GP have been thoroughly studied in the past. In animal models, GP and the resulting overflow of bile and/or stones have been demonstrated to be safe and do not induce infection or death during the follow-up period [23, 24]. The results of human investigations, on the other hand, are still debatable. Although GP, at least theoretically, causes bile, calculi, and germs to contaminate the peritoneal cavity, some experts feel that the negative effects of spillage following GP during laparoscopic cholecystectomy can be mitigated by rapid recovery of as many spilled stones as feasible, enough peritoneal cavity irrigation, and enough antibiotic treatment [6]. Most studies have found that GP did not increase the risk of complications, reoperations, or hospital stay [6, 25]. According to a recent prospective research, GP and retained gallstones had no negative effects on respiratory mechanics or post-operative discomfort [9]. Furthermore, because bile is usually polluted in the presence of gall stones, several investigations have revealed negative implications of bile spilling owing to GP [26]. In an analysis of 1059 consecutive laparoscopic cholecystectomies, increased incidence of fever and intraabdominal abscesses were discovered if GP occurred at the time of surgery. [20]. Retained gallstones and bile leakage have also been linked to infection, abscesses, fibrosis, adhesions, cutaneous sinuses, small-bowel blockages, and widespread septicemia in some case reports [27, 28]. Finally, in a study of individuals with a loss of numerous or large pigment stones that cannot be recovered by laparoscopy, conversion to open surgery was advised [4]. However, we think that the negative implications of spilling after GP during laparoscopic cholecystectomy can be avoided by retrieving as many of the spilled stones as feasible as soon as feasible, enough irrigation of the peritoneal cavity, and enough preventive antimicrobial prophylaxis [6], as previously noted. We discovered that GP and subsequent intraabdominal contamination do not enhance the risk of complications or change the results in the early postoperative period using this method. As a result, the current study finds that GP increases the usage of drains and lengthens the operation duration, both of which are likely side effects of GP because stone removal and peritoneal irrigation are necessary in these circumstances. The current study, on the other hand, showed no other negative effects of GP in patients who had laparoscopic cholecystectomies. Similar short- term problems in individuals with GP, on the other hand, may be linked to the therapeutic technique used. Furthermore, many of the recognized complications associated with split gallstones are long-term, occurring often beyond a year. As a result, we are unable to speculate on potential long-term consequences based on the findings of this study. As a result, we conclude that GP should be avoided wherever feasible, but that the outcomes are unaffected if specific standards for minimizing contamination are followed. Finally, the outcomes of two patients with gallbladder cancer in the current investigation must be detailed. Because their pathology results ruled out early T1 tumors, these individuals had further surgeries, including partial hepatic resections and lymph node dissection in the hepatic hilum. However, in one case, bile overflow resulted in tumor implantation on the stomach's front wall, necessitating a distal gastrectomy. Tumor leakage, we feel, is the most serious adverse effect of GP, but it is also a rare complication since incidental gallbladder cancer is uncommon in individuals undergoing elective cholecystectomy.

Because of its retrospective character, the current study has several limitations. The significance of the current data is limited due to missing information, including the lack of operation CDs for 60 patients. Furthermore, the study's conclusions may be questioned from a variety of perspectives. First, despite the statistical significance of the difference, we do not know if a 6-minute increase in operating time reflects importance in everyday practice. Furthermore, the increasing usage of drains in the Perforation group might be due to a lack of clear- cut criteria for when a drain should be installed. This might be due to the study's retrospective character. Furthermore, though GP may not have caused the increase in operation time or the need for drain utilization, all three endpoints happened as a result of the operation's difficulties. Because all staff surgeons do not have the same skill, the current study results addressing the experiences of the surgeons may be questioned. Furthermore, because the surgeons are aware that their actions are being filmed, they may be more careful, which might affect our results.

Finally, the current study found that GP occurs in 36.1 % of patients undergoing laparoscopic elective cholecystectomy, but is less frequently mentioned in the operation notes. GP is unexpected since there are likely no risk factors that enhance the chance of GP, with the exception of a preoperatively evaluated increased ALT level, which has a low sensitivity and specificity. Patients with GP had comparable early postoperative outcomes as those without, although the operation duration is longer and the use of drains is more common in patients with GP.

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