

# Risk Factors and Complications Associated with Difficult Emergency Cholecystectomies: Experience of a Single Urban Center

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## ABSTRACT

**Aim and objective:** The aim and objective of this study is to determine the prevalence, risk factors, and complications of difficult cholecystectomy in our population.

**Materials and methods:** A retrospective study was conducted from January 2016 through March 2017. Difficult cholecystectomy was the primary endpoint as defined by the surgeon in the operative report. Preoperative risk factors evaluated included: age, sex, obesity, pregnancy, resolved pancreatitis, choledocholithiasis resolved by endoscopic retrograde cholangiopancreatography (ERCP), and surgical wait time. Intraoperative factors evaluated including the presence of anatomical variants, operative time >90 minutes, and the presence of liver disease. We measured the rate of conversion from laparoscopic to open, the incidence of postoperative complications, and overall mortality in this population.

**Results:** Of 585 patients, 77.9% were admitted for acute cholecystitis, and 22.1% for symptomatic cholelithiasis, acute pancreatitis, or choledocholithiasis treated by ERCP. The prevalence of difficult cholecystectomy in our population was 37.6%. Preoperative risk factors correlating with difficult cholecystectomy included: male sex, and age >65 years. Intraoperative risk factors included: the presence of an anatomic variant and surgical time >90 minutes.

**Conclusion:** The prevalence of difficult emergency cholecystectomy at our institution is high. There was a low rate of complications and conversion among patients with difficult cholecystectomies.

**Keywords:** Acute cholecystitis, Biliary colic, Difficult cholecystectomy, Laparoscopic cholecystectomy, Subtotal cholecystectomy.

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## BACKGROUND

In Ecuador, gallbladder pathology is the leading cause of morbidity among women and the fifth cause among men.<sup>1</sup> While often asymptomatic, gallstones can become symptomatic leading to acute cholecystitis, cholangitis, choledocholithiasis, and acute biliary pancreatitis at a rate of 1–2% per year.<sup>2</sup> Laparoscopic cholecystectomy is the gold standard for the management of symptomatic gallbladder disease,<sup>3</sup> as it is associated with less pain, less morbidity, and earlier recovery.<sup>2,4,5</sup>

The level of complexity of a cholecystectomy is hard to predict. Knowledge and surgical expertise are fundamental to be able to safely execute these cases.<sup>4,6,7</sup> There is no accepted scoring system.<sup>6</sup> There are, however, various classifications describing the severity of acute cholecystitis including the AAST classification (Table 1). There are established preoperative risk factors for difficult cholecystectomy such as the presence of acute cholecystitis, male sex, advanced age, history of recurrent episodes of acute cholecystitis leading to fibrosis and adhesions, obesity, and cirrhosis.<sup>8–10</sup> There are also intraoperative risk factors including the presence of severe fibrosis, scleroatrophic gallbladder, Mirizzi syndrome, gallbladder empyema, dilated and short cystic duct, biliary and vascular anatomical variants,<sup>2,11</sup> total operative time of >90 minutes, as well as dissections of Calot's triangle lasting >20.<sup>3</sup>

Our work aims to describe the incidence, the risk factors, and outcomes associated with difficult cholecystectomy in our population in Southern Ecuador.

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## MATERIALS AND METHODS

Using operative reports, a retrospective study was carried out from January 2016 through March 2017. This study included

**Table 1:** AAST cholecystitis severity scale

Grade	Grade I	Grade II	Grade III	Grade IV	Grade V
Description	Acute cholecystitis	GB empyema or gangrenous	GB perforation with local contamination	GB perforation with pericholecystic abscess or gastrointestinal fistula	GB perforation with generalized peritonitis
Clinical	RUQ or epigastric pain, Murphy sign, leukocytosis	RUQ or epigastric pain, Murphy sign, leukocytosis	Localized peritonitis in RUQ	Localized peritonitis at multiple locations, abdominal distention with symptoms of bowel obstruction	Grade IV, with generalized peritonitis
Imaging	Wall thickening, distention gallstones or sludge, pericholecystic fluid, no visualization of GB on HIDA scan	Grade I plus the air in GB lumen wall, or in the biliary tree; focal mucosal defects without frank perforation	HIDA with focal transmural defect, extraluminal fluid collection, or radiotracer but limited to RUQ	Abscess in RUQ outside GB, bilioenteric fistula, gallstone ileus	Free intraperitoneal bile
Operative	Inflammatory changes localized to GB, wall thickening, distention, gallstones	Distended GB with pus or hydrops, necrosis or gangrene of wall, not perforated	Perforated GB wall (non-iatrogenic) with bile outside the GB but limited to RUQ	Pericholecystic abscess, bilioenteric fistula, gallstone ileus	Grade IV, plus generalized peritonitis
Pathologic	Acute inflammation changes in the GB wall without necrosis or pus	Grade I plus pus in GB lumen, necrosis of GB wall, intramural abscess, epithelial sloughing, no perforation	Necrosis with perforation of the GB wall (non-iatrogenic)	Necrosis with perforation of the GB wall (non-iatrogenic)	Necrosis with perforation of the GB wall (non-iatrogenic)

HIDA, hepatobiliary iminodiacetic acid scan; RUQ, right upper quadrant

patients who presented to the acute care surgical service by way of the emergency room with acute cholecystitis, symptomatic cholelithiasis, resolved acute biliary pancreatitis, and/or choledocholithiasis previously resolved by endoscopic retrograde cholangiopancreatography (ERCP). Patients who required common bile duct exploration and who had previously undergone percutaneous cholecystostomy tube placement were excluded. Data were collected from the operative reports of the seven acute care surgeons working at our institution. The following preoperative risk factors were evaluated: age, sex, obesity (BMI  $\geq 30$ ), pregnancy, presence of resolved pancreatitis, presence of choledocholithiasis resolved by ERCP, and surgical wait time. The following intraoperative risk factors were also evaluated: the presence of anatomical variants (biliary and vascular), operative time  $>90$  minutes, and the presence of liver disease (hepatomegaly, nodular liver, cirrhosis). We also evaluated the conversion rate from laparoscopic to open, postoperative complications, and mortality rate.

The primary endpoint for this study was the incidence of *difficult cholecystectomy*, defined by the operating surgeon in his or her operative report based on the presence of any one of the following criteria: gangrenous cholecystitis, severe adhesions of nearby structures to the gallbladder, suppurative cholecystitis, perivesicular abscess, the presence of severe adhesions, inability to identify the critical view of safety (CVS), scleroatrophic gallbladder, Mirizzi syndrome, and gallbladder perforation with localized or generalized peritonitis.

All patients were operated on by the same group of seven surgeons using the same operative technique which included open Hasson entry into the abdomen, establishment of pneumoperitoneum at 12–14 mm Hg, and dissection of Calot's triangle using four laparoscopic ports. We quantified the number of patients who underwent a rescue cholecystectomy, which included:

retrograde, fenestrative, and reconstituting subtotal and modified Pribram cholecystectomy. The type of cholecystectomy performed depending on the comfort level of the attending surgeon in the case.

### Statistical Analysis

The data from the operative reports were entered into a database that was subsequently tabulated in the SPSS v. 20.0 and Epidat 3.1 program. Bivariate and multivariate analyses were performed, yielding 95% confidence intervals corresponding to a significance level of  $p \leq 0.05$ . A Mann–Whitney test was performed to obtain medians in quantitative variables.

## RESULTS

### Demographic Data

A total of 585 patients were studied, 175 (29.9%) men, and 410 (70.1%) women, with a combined mean age of  $40.48 \pm 16.3$  years (range 16–94 years). Of the 585 patients, 456 (77.9%) were admitted for acute cholecystitis, and 129 (22.1%) for symptomatic cholelithiasis, acute biliary pancreatitis, or choledocholithiasis post-ERCP (Table 2).

Difficult cholecystectomy was described in 220 of the 585 patients, representing a prevalence of 37.6%. Of the 220 difficult cholecystectomies performed, a rescue cholecystectomy technique was used in 90 (40.9%) cases. Of these, 63.33% were retrograde, 14.44% were reconstituting subtotal, 0.9% were fenestrative subtotal, and 21.11% were modified Pribram type.

The mean operative time for all patients undergoing cholecystectomy at our institution during this period was  $77.86 \pm 31.74$  minutes. The mean operative time for patients with a difficult cholecystectomy was  $104.92 \pm 33.9$  minutes. The mean operative time for a cholecystectomy that was not considered difficult was  $61.55 \pm 14.68$  minutes. The mean surgical wait time in acute cholecystitis and symptomatic cholelithiasis was 6.9 hours. The

mean surgical wait time in resolved biliary pancreatitis was 29 hours. The surgical wait time could not be calculated for patients with choledocolithiasis as, given the limited resources at our institution, patients had to be sent to outside institutions to undergo ERCP. The time to ERCP depended on the resources of the patient and the availability of ERCP at outside institutions.

Bivariate analysis showed a statistically significant association between difficult cholecystectomy and male sex, age >65, and choledocolithiasis resolved with ERCP ( $p < 0.05$ ). No statistically significant association was found between difficult cholecystectomy and obesity. Resolved biliary pancreatitis was found to be a protective factor for difficult cholecystectomy (Table 3). Likewise, the bivariate analysis demonstrated that operative time >90 minutes and the presence of anatomic variant were also associated with difficult cholecystectomy (Table 4).

**Table 2:** Demographic variables for included patients ( $n = 585$ )

	Variable	Frequency (n)	Percentage
Sex	Male	175	29.9
	Female	410	70.1
Age	<18 years	13	2.2
	19–35 years	256	43.8
	36–64 years	254	43.4
	>64 years	62	10.6
Comorbidities	Present	79	13.5
	No comorbidities	506	86.5
Diagnosis	Acute cholecystitis	376	64.2
	Symptomatic cholelithiasis	64	10.9
	Choledocolithiasis	54	9.2
	Biliary pancreatitis	91	15.5
Type of surgery performed	Laparoscopic cholecystectomy	488	83.4
	Laparoscopic converted to open cholecystectomy	7	1.1
	Rescue cholecystectomy	90	15.4

Multivariate analysis demonstrated five predictive factors, preoperative and intraoperative, for difficult cholecystectomy. These include male sex, age >65, presence of comorbidities, operative time >90 minutes and presence of anatomical variant. This model demonstrates that if none of the factors are present, the risk of having a difficult cholecystectomy is 13.93%. On the other hand, if all factors are present, the possibility of difficult cholecystectomy is 99.87% (Table 5).

**Risk Factors**

It was found that the median age >65 and male sex ( $p < 0.05$ ) were associated with difficult cholecystectomy. Median surgical time was higher for men than for women (86.73 minutes in men and 74.07 minutes in women,  $p < 0.05$ ). Of the 410 women, 8 (1.95%) were pregnant, with 1 (12.5%) in the first trimester and 7 (87.5%) in the second trimester. None (0%) presented with a difficult cholecystectomy. Likewise, obesity was present in 17 patients but was not found to increase the risk of difficult cholecystectomy in our population ( $p = 0.414$ ).

Post-ERCP cholecystectomy in the setting of choledocolithiasis was not found to increase the likelihood of difficult cholecystectomy ( $p = 0.928$ ). Patients presenting for cholecystectomy after resolved biliary pancreatitis, on the other hand, were less likely to have a difficult cholecystectomy ( $p < 0.05$ ).

Regarding intraoperative findings, a cholecystectomy was more likely to be considered difficult if the operative time lasted >90 minutes ( $p < 0.05$ ) or if an anatomic variant was present ( $p < 0.05$ ).

**Complications**

Thirteen patients (2.2%) in our sample experienced postoperative complications. Nine of these patients had undergone a difficult cholecystectomy and four had undergone a non-difficult cholecystectomy. A difficult cholecystectomy was associated with an increased risk of postoperative complications [OR 3.84 (1.17–12.65) ( $p < 0.05$ )]. The conversion rate was 1.19% (seven patients). All patients in which conversion from laparoscopic to open surgery occurred were classified as difficult cholecystectomy. One patient (0.17%) in our sample, who was classified as having had a difficult cholecystectomy, died. This patient was a 94-year-old woman who had undergone a laparoscopic converted to

**Table 3:** Bivariate analysis of preoperative findings and their association with the presence of a difficult cholecystectomy

Preoperative finding		Difficult LC (%)	Simple LC (%)	p value	Bivariate analysis OR (CI 95%)
Sex	Male	98 (16.8)	77 (13.2)	* $<0.05$	3.00 (2.08–4.33)
	Female	122 (20.9)	288 (49.2)		
Age	≥65 years	32 (5.5)	30 (5.1)	* $<0.05$	1.90 (1.11–3.22)
	≤65 years	188 (32.1)	335 (57.3)		
Comorbidity	Presence	42 (7.2)	37 (6.3)	* $<0.05$	2.09 (1.29–3.37)
	Absence	178 (30.4)	328 (56.1)		
Obesity	Presence	8 (1.4)	9 (1.5)	0.414	1.49 (0.56–3.92)
	Absence	212 (36.2)	356 (60.9)		
Cholecystectomy post ERCP	Yes	20 (3.4)	34 (5.8)	0.928	0.97 (0.54–1.73)
	No	200 (34.2)	331 (56.6)		
Cholecystectomy post pancreatitis	Yes	23 (3.9)	68 (11.6)	** $<0.05$	0.50 (0.30–0.84)
	No	197 (33.7)	297 (50.8)		

\*Significant statistical association as a risk factor

\*\*Significant statistical association as a protective factor

Yates correction was applied for the variables that presented a number <5 in one of their fields



**Table 4:** Bivariate analysis of intraoperative findings and their association with the presence of a difficult cholecystectomy

Intraoperative finding		Difficult LC (n, %)	Simple LC (n, %)	p value	Bivariate analysis OR	Confidence interval
Liver disease	Present	9 (1.5)	3 (0.5)	*<0.05	5.14	1.37–19.22
	Absence	211 (36.1)	362 (61.9)			
Operative time	≥90 minutes	128 (21.9)	7 (1.2)	*<0.05	71.15	32.14–157.49
	≤90 minutes	92 (15.7)	358 (61.2)			
Anatomic variant	Present	6 (1)	1 (0.2)	*<0.05	10.20	1.22–85.34
	Absent	214 (36.6)	364 (62.2)			

\*Significant statistical association as a risk factor

Yates correction was applied for the variables that presented a number <5 in one of their fields

**Table 5:** Multivariate analysis of preoperative and intraoperative risk factors for difficult cholecystectomy

Variable	OR	Confidence interval 95%	p value
Preoperative risk factors			
Male sex	2.88	1.79–4.63	<0.05
Age	1.03	1.01–1.04	<0.05
Presence of comorbidities	1.96	1.06–3.63	<0.05
Pancreatitis	0.45	0.20–0.99	<0.05
Intraoperative risk factors			
Presence of anatomic variant	12.70	1.15–139.83	<0.05
Surgical time >90 minutes	70.133	31.32–157.00	<0.05

open cholecystectomy for severe adhesive disease. Her death was attributed to postoperative nosocomial pneumonia.

Biliary duct injury occurred in four patients (0.68%), three of which had been classified as a difficult cholecystectomy, and one had not been classified as a difficult cholecystectomy. The three cases of bile duct injuries in cases classified as difficult cholecystectomies were recognized and treated intraoperatively. The one patient with a bile duct injury that did not occur in a difficult cholecystectomy was recognized postoperatively. In zero of the three patients with bile duct injury was a rescue technique performed. A summary of bile duct injuries that occurred in these patients is summarized in Table 6.

Other complications included postsurgical bleeding resulting in hemoperitoneum in two patients (0.34%). The source of the bleeding was noted to be an umbilical port in one patient and the surgical bed in the second patient. Both required laparoscopic reintervention for the management of hemorrhage. Residual choledocolithiasis was found in six patients (1.02%) postoperatively. Three of these patients had undergone a rescue cholecystectomy. All six were managed successfully with postoperative ERCP. A subhepatic collection was found postoperatively in one patient who had undergone a fenestrative cholecystectomy. This patient was managed with laparoscopic drain placement and subsequent ERCP with stent placement in the common bile duct.

## DISCUSSION

Hospital Vicente Corral Moscoso is a tertiary care center in Southern Ecuador, with an Acute Care Surgery Service that can immediately care for acute gallbladder pathologies. During the surgical dissection of Calot's triangle, identifying the CVS is paramount for achieving a safe cholecystectomy.<sup>9,12</sup> However, there are situations wherein Calot's triangle is distorted by anatomic variants or severe

**Table 6:** Bile duct injuries in our sample by the Bismuth-Strasberg classification

Class	Number of cases	Timing of diagnosis	Management
(A) Bile leak from cystic duct or liver bed	1	Postoperative	ERCP
(B) Occlusion of the right segmental duct	0		
(C) Bile leak from divided right segmental duct	0		
(D) Lateral injury to the common hepatic duct			
(E1) Main bile duct injury, >2 cm from the confluence	0		
(E2) Main bile duct injury, <2 cm from the confluence	1	Postoperative	Hepaticojejunostomy
(E3) Hilar injury with intact confluence	0		
(E4) Confluence involved, right and left hepatic ducts are separated	2	Intraoperative	Hepaticojejunostomy
(E5) Injury of aberrant right sectoral duct with concomitant injury of main bile duct	0		

inflammation.<sup>13</sup> In these cases, several surgical techniques can be used to avoid vascular and bile duct injuries. These include aborting the procedure and placing a cholecystostomy tube, antegrade gallbladder dissection, and rescue cholecystectomy.<sup>14,15</sup> The information gained from our experience in detecting and predicting difficult cholecystectomy can help with both preoperative and intraoperative decision-making among surgeons including the decision to perform a damage control cholecystectomy, help to inform the patient of the possible findings and associated risks of surgery before entering in the operating room, and allow for appropriate equipment and expertise to be available during a difficult case.

We have described a prevalence of difficult cholecystectomy of 37.6%. This rate is higher than described by Randhawa and

Pujahari, which quoted an incidence of 21.9% in 228 laparoscopic cholecystectomies.<sup>6</sup>

## Preoperative Factors

### Advanced Age

Patients older than 65 years old have a higher risk of difficult cholecystectomy. The incidence of gallstones, the lithogenicity of bile, and gallbladder dysfunction are all factors known to increase with age and may contribute to this association.<sup>16</sup> These findings have been corroborated by Bourgooin et al. who identified an increased risk of difficult cholecystectomy in patients over 70 in a sample of 644 patients,<sup>17</sup> and by Alnaimy et al. who identified that 79% of patients over 50 presented with difficult cholecystectomy in a prospective study of 250 patients.<sup>11</sup>

### Male Sex

While overall more females present for laparoscopic cholecystectomy, male patients present with a higher risk of difficult cholecystectomy. Indeed, other studies have found that the conversion rate was higher in males due to difficult cholecystectomy.<sup>6,18</sup> It has been suggested that this finding may be due to males being more likely to delay medical attention.<sup>19</sup>

### Obesity

We did not identify an increased risk of difficult cholecystectomy in obese patients, coinciding with the findings of several recent studies which have found a not statistically significant correlation between obesity and difficult cholecystectomy.<sup>10,16,20</sup> Obesity in Ecuador, however, is not as prevalent as in other countries.

### Choledocolithiasis Resolved with ERCP and Gallstone Pancreatitis

We have described no increased risk of difficult cholecystectomy in patients who underwent ERCP before cholecystectomy for the diagnosis of choledocolithiasis, or in patients with resolved gallstone pancreatitis. These results coincide with those of Sutcliffe et al., which there was no increased risk of conversion in patients diagnosed with choledocolithiasis or gallstone pancreatitis in a sample size of 8820 patients.<sup>12</sup>

## Intraoperative Factors

### Liver Disease

We found that patients with liver disease such as hepatomegaly or cirrhosis present a higher risk of having a difficult cholecystectomy. This increased risk is largely attributed to increased intraoperative bleeding. Some publications, therefore, have suggested that the presence of liver disease by nature makes a cholecystectomy difficult.<sup>21,22</sup>

### Anatomical Variation

The presence of anatomical variant was also found to be a risk factor for a cholecystectomy being considered difficult in our cohort. Carrasco et al. cited the presence of anatomical variants as a cause of conversion.<sup>18</sup>

### Operative Time

Our study found that operative time >90 minutes was proportionally related to difficult cholecystectomy (OR 71.15,  $p < 0.05$ ). This finding is corroborated by other studies which have suggested that an operative time of >60 minutes is a marker for difficult cholecystectomy.<sup>23</sup>

## Conversion to an Open Procedure

Despite a high prevalence of difficult cholecystectomy in patients presenting acutely rather than electively, we describe a conversion rate of 1.19% (seven patients). A similar rate of conversion of 1% was described in a sample of 148 patients undergoing emergency cholecystectomies with a retrograde cholecystectomy technique.<sup>24</sup>

A sample of 210 elective gallbladders described a conversion rate was 4.28%;<sup>20</sup> likewise, a conversion rate of 3.41% in a sample of 586 elective cholecystectomies has also been described.<sup>25</sup> A sample of 915 patients described by Akcakaya et al. had a conversion rate of 4.7% in both elective and emergency patients.<sup>19</sup>

## Management Strategies of a Difficult Chole

The goal of cholecystectomy for acute gallbladder pathologies is to reduce complications and to avoid injuries to surrounding structures by way of safe, rigorous dissection. At times, performing a "rescue" procedure rather than a total cholecystectomy is the safest option for the patient. In our study, when the CVS was not achieved, a rescue cholecystectomy was performed. Both reconstructive and fenestrating subtotal cholecystectomies are associated with decreased morbidity in patients with difficult cholecystectomies.<sup>15,26,27</sup> The dome down retrograde approach has also already been shown to be an effective tool in avoiding injuries and complications in the setting of acute cholecystitis.<sup>28</sup>

## LIMITATIONS

This was a retrospective study performed at a single institution. Moreover, the definition of "difficult cholecystectomy" is ultimately subjective. What may be considered a difficult cholecystectomy may vary significantly from surgeon to surgeon. Identification of a "difficult cholecystectomy" relied upon the documentation in the operative report and was heavily dependent on the surgeon taking the time to detail the case.

## CONCLUSION

The prevalence of difficult cholecystectomy at our institution was high. The statistically significant preoperative factors found to be associated with difficult cholecystectomy included: age older than 65, male sex and the presence of comorbidities. The statistically significant intraoperative factors found to be associated with difficult cholecystectomy included: the presence of anatomical variants, liver disease, and surgical time >90 minutes. At our institution, we describe a low rate of complications and conversion.

## DECLARATIONS

The research was carried out with the approval of the Committee of Ethics and Research in Humans of the Vicente Corral Moscoso Hospital. Informed consent was provided before surgical intervention and for the use of their data in the study. The data were used exclusively for research.

The datasets generated during this study are available from the corresponding author on reasonable request. All data generated during this study are included in this published article.

## AUTHOR'S CONTRIBUTIONS

DSA: Data collection, statistical analysis, writing of the manuscript; FDAC: Data collection; NFL: Data collection, writing of the

manuscript; AH: Translation, writing of the manuscript; JCP: Review of manuscript, translation; JCSM: Review of manuscript.

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