Original Article

Risk Factors of Difficult Laparoscopic Cholecystectomy for Acute Cholecystitis in Acute Care Surgery Patients

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Background: Laparoscopic cholecystectomy (LC) now is considered as a treatment of choice for the management of acute cholecystitis (AC) around the world. Conversion rates of LC in urgency or emergency setting has increased.

Objective: The present study aimed to identify risk factors signifying difficulty during performing LC for acute cholecystitis in acute care patients.

Materials and Methods: Electronic Medical Records (EMR) of 103 acute cholecystitis patients in Acute Care Surgery service in Ramathibodi Hospital, between 1 January and 31 December 2017, were reviewed. Thirty-eight patients who underwent urgency LC were enrolled and divided into difficult LC and not-difficult LC groups. Pre-operative characteristics and postoperative outcomes were analyzed.

Results: From 38 cases, 35 cases were in the not-difficult group and 3 cases were in the difficult group. Age, severe inflammation at Hartmann pouch, and intra-operative findings of gangrene gallbladder were risk factors for difficult LC's that met statistical significance, *p*-value = 0.023, 0.026, and 0.025, respectively.

Conclusion: From the present study, risk factors for difficult LC's in urgency acute cholecystitis is age, severe inflammation of Hartmann's pouch, and intra-operative findings of gangrene gallbladder. The reason why we have only 3 difficult LC cases from a total of 38 LC cases is due to pre-operative ultrasound findings of gallbladder wall necrosis and old age. They are the significant factors that make the surgeon's decision to do OC first. Intra-operative findings of OC are GB necrosis according to pre-operative ultrasound, also.

Keywords: LC, Acute care surgery, Difficult LC

Early cholecystectomy was recommended for urgency settings of acute cholecystitis[1]. Laparoscopic cholecystectomy (LC) and is considered the treatment of choice for the management of acute cholecystitis (AC) around the world[1]. However, it may be difficult to perform LC in urgency or emergency settings for acute cholecystitis due to the patient's clinical conditions and the surgical pathology of the gallbladder. Conversion rate to open surgery also increases according to the severity criteria in the 2018 Tokyo Guidelines[1]. There are many risk factors that make for difficult LC's such as clinical peritonitis, leukocytosis, and necrotizing cholecystitis[2]. In urgency or emergency situations, continuing LC with increasing blood loss and long operative time in sepsis patients may lead to high risk of complications such as hypovolemic shock, septic shock, and bile duct injury. Pre-operative or intra-operative prediction of difficult LC's are important for surgical planning to prepare appropriate equipments, time and team for a safe operation. In this study, we analyzed the clinical and operative data of patients who underwent LC for acute cholecystitis to evaluate risk factors predicting difficult LC in acute cholecystitis in service of Acute Care Surgery Unit, Ramathibodi Hospital.

Materials and Methods
Patients and data

A retrospective reviewed of 103 patients' EMRs with acute cholecystitis in service of Acute Care Surgery (ACS), Department of Surgery, Ramathibodi Hospital between 1 January 2017 and 31 December 2017 was conducted. The authors excluded 20 patients who underwent predetermined open cholecystectomy (OC), 5 patients who got percutaneous drainages (PCD), 26 patients under antibiotic treatment and planned but postponed cholecystectomy; 14 patients had data loss, and patients

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who had septic shock on admission from this study are as shown in Figure 1. The patients were divided into 2 groups, the difficult LC group and the other not-difficult LC group. Subgroup analysis was done to identify the clinical risk factors for the difficult LC (Table 1). A case of a difficult LC was defined by any cases with operation time >3 hours and/or intra-operative blood loss >300 ml and/or conversion to open cholecystectomy. The operative time was defined as the time from skin incision to skin closure. A diagnosis of acute cholecystitis and indication for LC was according to the Tokyo Guidelines 2018[(1)].

LC were performed by ACS surgeons or hepatopancreatobiliary (HPB) surgeons, assisted by general surgery residents or fellows in related fields of training, using 3 or 4 ports methods under general anesthesia (GA). Informed consent was obtained from all patients before the procedure, after patients had known and discussed the alternative for the procedure, results, risks and possible complications.
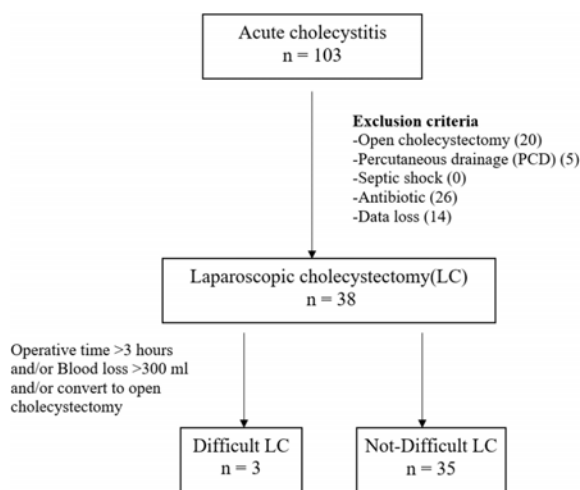
OC = Open cholecystectomy, LC = Laparoscopic cholecystectomy

Figure 1. Selective flowchart of the study.

Table 1. Patient characteristic between LC group

Factor	Difficult LC n = 3	Non-difficult LC n = 35	p-value
Female/male, n (%)	22 (62.862)/2 (66.67)	1 (33.33)/13 (37.14)	0.550
Age (years) (SD; min-max)	80 (63 to 91)	53.8 (25 to 91)	0.023*
BMI; median (IQR; p75-p25)	28.4 (20.2 to 34)	25.32 (20 to 42)	0.450
Previous abdominal surgery, n (%)	1 (33.33)	3 (8.57)	0.291
Onset of symptom (hours), median (IQR; p75-p25)	25.33 (4 to 48)	40.77 (3 to 120)	0.377
Preoperative peritonitis, n (%)	1 (33.33)	0 (0)	0.079
Preoperative WBC	16,900 (15,600 to 18,700)	12,356.76 (1,500 to 24,400)	0.121

LC = Laparoscopic cholecystectomy, BMI = Body mass index

Statistical analysis

Patient demographics and operative data were analyzed by Chi-square, Fisher exact test and Wilcoxon rank sum test. The statistical significance of the differences was significant when p-value was <0.05.

Results

There were 3 cases of difficult LC and 35 cases of not-difficult LC. The patients demographic data compared between LC group were not statistical significant except for age, 80 years in difficult LC and 53.8 years in non-difficult LC, p-value = 0.023 (Table 1). No cases had any postoperative complications. The operative data between difficult LN and non-difficult LC were shown in Table 2. There was severe inflammation at Hartmann's pouch, and intra-operative findings of gangrene gallbladder that reached statistic significance, p-value = 0.026 and 0.025, respectively. Other factors: concomitant cholangitis, GB wall necrosis by preoperative ultrasound, operative period before or after midnight, time from ER to OR, intra-operative GB decompression, cystic duct size, and ERCP before LC in the same operation did not reach statistical significance. Subgroup analysis between OC and LC patients was shown in Table 3 and 4. Only age of the patients reached statistical significance, 66.1 years in OC group and 54.66 years in LC group, p-value 0.023. Sex, BMI, previous abdominal surgery, onset of symptom, preoperative peritonitis, and preoperative WBC are no statistic significant. From operative related data between OC and LC, preoperative ultrasound findings of GB wall necrosis, intra-operative gross findings, and pathologic diagnosis of chronic cholecystitis has statistical significant, p-value = 0.018, 0.007, 0.019, respectively.

Discussion

Laparoscopic cholecystectomy (LC) is a standard procedure for urgency treatment of acute cholecystitis due to the development of surgical technique and laparoscopic instruments, including surgeon experience[(3)]. Sometimes, an urgency LC for acute cholecystitis is difficult, some cases need conversion to open surgery concerning for patient safety. The conversion rate varies from 6 to 32%[(4)], decision for conversion depends on the skill of surgeons, patients

Table 2. Operative related data between difficult and not-difficult LC patients

Characteristic	Difficult LC n = 3	Not-difficult LC n = 35	*p*-value
Cholangitis, n (%)	0 (0)	10 (28.57)	0.522
Preoperative ultrasound GB wall thickness (mm)	6.65 (3.3 to 10)	4 (3 to 6)	0.520
Preoperative ultrasound findings of GB wall necrosis	0 (0)	1 (2.86)	0.999
Operation before midnight/after midnight, n (%)	2 (66.67)/1 (33.33)	31 (88.57)/4 (11.43)	0.353
Time from ER to OR (minutes)	180 (120 to 1,440)	180 (75 to 303)	0.462
ERCP before LC, n (%)	0 (0)	3 (8.57)	0.999
GB decompressed, n (%)	3 (100)	27 (77.14)	0.999
Severe inflammation at Hartmann pouch, n (%)	3 (100)	9 (25.71)	0.026*
Intraoperative GB wall (mm)	5 (4 to 6)	4 (4 to 6)	0.579
Cystic duct size (mm)	5 (3 to 10)	4 (3 to 5)	0.537
Intraoperative gross findings, n (%)			
Mild inflammation	0 (0)	15 (42.86)	0.264
Edematous	1 (33.33)	14 (40)	0.999
Empyema	0 (0)	4 (11.43)	0.999
Gangrene	2 (66.67)	2 (5.71)	0.025*
Pathological diagnosis, n (%)			
Chronic cholecystitis	0 (0)	9 (25.71)	0.999
Suppurative cholecystitis	1 (50)	3 (8.57)	0.207
Acute cholecystitis	0 (0)	15 (42.86)	0.505
Acute cholecystitis with focal rupture	1 (50)	2 (5.71)	0.158
Acute and chronic cholecystitis	0 (0)	6 (17.14)	0.999

LC = Laparoscopic cholecystectomy

Table 3. Patient characteristic between OC and LC patients

| Factor	OC n = 20	LC n = 36	*p*-value
Female/male, n (%)	10 (50)/10 (50)	22 (16.11)/14 (38.89)	0.574
Age (years) (SD; min-max)	66.1 (44 to 96)	54.66 (25 to 91)	0.023*
BMI; median (IQR; p75-p25)	24 (8; 28 to 20)	25 (7; 30 to 23)	0.096
Previous abdominal surgery, n (%)	2 (10)	4 (11.11)	0.999
Onset of symptom (hours), median (IQR; p75-p25)	24 (24; 48 to 24)	24 (48; 72 to 24)	0.661
Preoperative peritonitis, n (%)	3 (15)	1 (2.78)	0.125
WBC, median (min-max)	12,553.61 (1,500 to 7,900)	13,635 (7,900 to 24,000)	0.414

OC = open cholecystectomy, LC = Laparoscopic cholecystectomy

condition, intra-operative finding, and is subjective. Now, to our knowledge, there is no consensus of definition of "difficult LC". So, the operative time and blood loss are acceptable parameters worldwide, the authors considered that the definition for difficult LC is appropriate[5]. In the present study, the authors used the surgeon's operative time and patient's blood loss to distinguish between non-difficult LC and difficult LC also. Acute cholecystitis is one of predictors for technical difficulties in LC, especially in severity grade II or III of Tokyo guidelines 2018 (TG18)[6] show difficulty score for each intraoperative finding to suggestion the surgeons should choose conversion to open cholecystectomy or bail-out procedures to prevent bile duct injury[3] (Figure 2). TG18 guidelines show the risk fac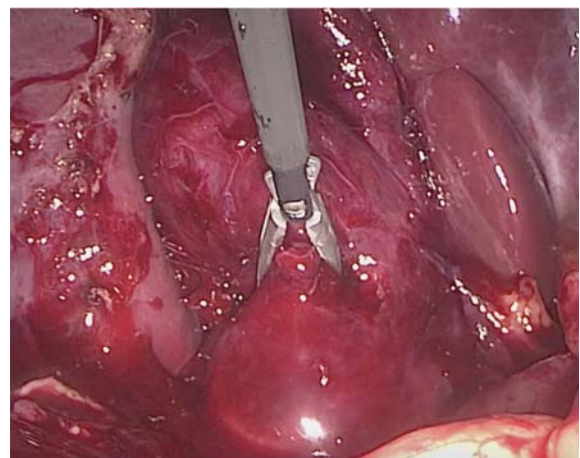tors associated with prolonged operative time and conversion to open cholecystectomy such as gallbladder wall thickening >4 to 5 mm, incarcerated stones in gallbladder neck, high BMI (body mass index), and unclear anatomy that may lead to a higher risk of intraoperative complications such as bile duct injury. In the present study, we found the risk factors are advanced age, severe inflammation at Hartmann's pouch of gallbladder, and intra-operative finding of gangrene gallbladder (Figure 3) and led to longer operative time, more blood loss, or conversion to OC. One of the techniques that makes LC non-difficult is intra-operative gallbladder decompression without statistical difference (Table 2). There were 3 difficult LC's from 38 urgency cases, due to our ACS staff selected to do OC first. From subgroup analysis between OC and LC cases, the

Table 4. Operative related data between OC and LC patients

Factor	OC n = 20	LC n = 36	p-value
Preoperative ultrasound finding GB wall necrosis	5 (25)	1 (2.78)	0.018*
Ultrasound GB wall thickness (mm), median (IQR; p75-p25)	5 (3; 7 to 4)	4 (3; 6 to 3)	0.077
Cholangitis, n (%)	4 (20)	9 (25)	0.752
Operative time (minutes), median	112.5 (140 to 82.5)	120 (165 to 105)	0.295
Operation before/after midnight, n (%)	14 (70)/6 (30)	31 (86.11)/5 (13.89)	0.174
GB decompression, n (%)	18 (90)	28 (77.78)	0.304
Inflammation at Hartman pouch, n (%)	7 (35)	10 (27.78)	0.762
Time from ER to OR (minutes), median	80 (225 to 45)	180 (316.5 to 90)	0.061
Intraoperative gross findings, n (%)			
Mild inflammation	3 (15)	14 (38.89)	0.062
Edematous	6 (30)	14 (38.89)	0.506
Empyema GB	2 (10)	4 (11.11)	0.898
Gangrenous GB	9 (45)	4 (11.11)	0.007*
Pathological diagnosis, n (%)			
Chronic cholecystitis	0 (0)	9 (25.71)	0.019*
Acute cholecystitis	6 (31.58)	13 (37.14)	0.413
Acute and chronic cholecystitis	3 (15.79)	6 (17.14)	0.771
Focal rupture	5 (26.32)	3 (8.57)	0.999
Suppurative	4 (21.05)	4 (11.43)	0.113
Gangrenous	1 (5.26)	0	0.352
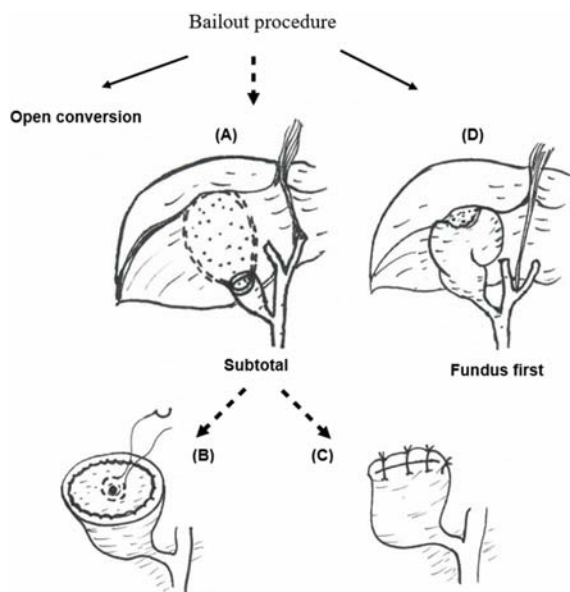
Figure 2. Bail-out procedure for difficult LC (A) subtotal cholecystectomy, (B) fenestrating (cystic duct is closed from inside), (C) reconstituting (closure of the remnant GB wall), (D) fundus first (Illustrate by Dr. Umaporn Seehawong[3]).

Figure 3. Intra-operative finding shown severe inflammation at Hartmann pouch of gallbladder.

operative time and operative period before or after midnight was not statistical significant. But, pre-operative ultrasound findings of GB wall necrosis are significant in the OC group, p-value = 0.018. This ultrasound finding is an important pre-operative tool for surgeons to decide to perform OC first. Intra-operative findings revealed that gangrenous GB is seen more in OC than LC, p-value = 0.007, according to pre-operative ultrasound findings. The pathologic report of OC has no chronic cholecystitis while LC has 9 cases, there is different with statistical significant p-value = 0.019 that means OC case has true acute cholecystitis one of the

risk factor of difficult LC.

Conclusion

From the present study, risk factor for difficult LC in urgency acute cholecystitis is age, severe inflammation of Hartmann's pouch, and intra-operative finding of gangrene gallbladder. The reason why we have only 3 difficult LC cases from total 38 LC cases is due to pre-operative ultrasound findings of gallbladder wall necrosis and old age are the significant factors that make surgeon's decision to do OC first. Intra-operative gross findings of OC are GB necrosis according to pre-operative ultrasound also.

What is already known on this topic?

Laparoscopic cholecystectomy (LC) now is considered as a treatment of choice for the management of acute cholecystitis (AC) around the world. Conversion rates of LC in urgency or emergency setting is increase due to difficulty of emergency setting procedure.

What this study adds?

The present study reveals the risk factors of a difficult LC and reminds surgeons and operative teams to be aware of conversion to open cholecystectomy (OC), and whether to do OC or LC first.

Potential conflicts of interest

The authors declare no conflicts of interest.

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