Emergency versus delayed laparoscopic cholecystectomy for acute cholecystitis

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Background
Acute cholecystitis (AC) is a major complication of gallstones. Laparoscopic cholecystectomy for AC has still not become routine because the timing and approach to the surgical management in patients with AC is still a matter of debate among general surgeons. The aim of this investigation is to clarify the safety and feasibility of the emergency or early laparoscopic cholecystectomy (ELC) for AC in comparison with the interval or delayed laparoscopic cholecystectomy (DLC) regarding procedure safety, operating time, injury to bile ducts, postoperative pain, total length of hospital stay, cost factor, loss of active days of work (days away from work), and conversions to open cholecystectomy.
Patients and methods
One hundred forty-eight patients were managed by laparoscopic cholecystectomy for AC and were randomized into two groups; the first (early) group (n=74) was managed by ELC and was carried out within 72 h of onset of symptoms, while the second (interval) group was managed by DLC and was carried out at least 6 weeks after symptoms settled. Clinical presentation, duration of symptoms, ultrasound findings, frequency of conversion to open operation, and numbers/types of complications were recorded. Moreover, the statistical analysis was carried out using the Statistical Package for Social Sciences.
Results
Our study claimed that ELC has a low conversion rate, shorter operative time, postoperative course, and significantly shorter total hospital stay (P<0.001) but longer operation time without an increase in morbidity to the patient.
Conclusion
Current evidence supports ELC as the preferred treatment strategy for patients presenting with AC. It allows a shorter hospital stay and greater patient satisfaction, but shares similar operative morbidity, mortality, and conversion rate as DLC.

Keywords:
acute cholecystitis, delayed laparoscopic cholecystectomy, early laparoscopic cholecystectomy

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Introduction

Laparoscopic cholecystectomy has been shifted from being considered a contraindication in the management of acute cholecystitis (AC) to being the most commonly performed procedure in AC patients in the last decade. This shift was driven by the increase in laparoscopic experience and the improvement in laparoscopic devices and instruments, which has led to improve the safety and reduced morbidities [1].

Laparoscopic cholecystectomy for AC has still not become routine because the timing and approach to the surgical management in patients with AC is still a matter of controversy [2].

The Tokyo guidelines of the Japanese Society of Hepato-Biliary-Pancreatic Surgery including diagnostic criteria, therapeutic strategies, and clinical flowcharts for acute cholangitis and cholecystitis where the severity of AC is graded as mild (grade I), moderate (grade II), or severe (grade III), with different recommendations of surgical treatment options [2].

The patients according to the Tokyo guidelines may be treated with emergency cholecystectomy or urgent gallbladder drainage, medical treatment, and delayed cholecystectomy [3].

Within 72 h after the onset of symptoms and before the development of fibrosis, laparoscopic cholecystectomy may be a safe procedure because the anatomy usually is clear and dissection may be guided by edema [4].

During the Tokyo Consensus Meeting in 2007, only 33% of Japanese surgeons were agreed with the policy of early laparoscopic cholecystectomy (ELC) [2].

Recently, there is increasing support for ELC especially with the publication of more randomized controlled trials which conclude that ELC is superior to delayed laparoscopic cholecystectomy (DLC) in terms of patient duration of hospital stay and costs [5].

The choice between the two methods of treatment is difficult as the data prospectively comparing them are sparse. Hence, we undertook a prospective, randomized study to compare the ELC and DLC in the treatment of AC. Laparoscopic cholecystectomy is considered to be the standard of care if the patient is seen within 48 h of the attack of AC because adhesions would not have developed so early after the onset of inflammation [6].

Most patients with AC of more than 72 h may have severe inflammation and dense adhesions that increase the risk of complications of laparoscopic cholecystectomy and conversion to open surgery. Therefore, these patients are frequently treated nonoperatively, discharged from the hospital when the acute attack has subsided, and treated with cholecystectomy 4–8 weeks later [7].

It is evident that DLC allows maturation of the inflammatory changes with consequent fibrosis, contraction, and adhesions that make the surgery potentially more difficult [8].

A recent meta-analysis of randomized clinical trials comparing ELC versus DLC for AC showed that early surgery results in a significantly shorter total hospital stay at the cost of a significantly longer operation time, with no significant differences in conversion rates or complications [9].

Aim of the work

The aim of our investigation is to assess the efficacy of the emergency or ELC for AC in comparison with the interval or DLC regarding procedure safety, operating time, injury to bile ducts, postoperative pain, total length of hospital stay, cost factor, loss of active days of work (days away from work), and conversions to open cholecystectomy.

Patients and methods

This was a prospective, observational, and comparative study, conducted in the Department of Surgery, Zagazig University Hospital, from December 2015 to June 2018.

Patients were randomized into two equal groups according to the timing of surgical operations, using a computer-generated random number. The first (early) group will undergo ELC within 72 h of symptom onset and the second (late) group that initially treated with broad-spectrum intravenous antibiotics and fluid resuscitation and then discharged, then readmitted for DLC at least 4 weeks after the initial admission.

Data collection

Patients' data were recorded at the time of admission including age, sex, associated comorbidities, BMI, past history of biliary disease, history of previous abdominal surgeries, and the clinical findings including the time of symptom onset, palpation of inflamed gallbladder, and vital signs in the emergency room and during admission as shown in Table 1.

Other data were collected prospectively including the laboratory data (white blood cell, serum bilirubin, amylase, and alkaline phosphatase), operative findings (type of the inflamed gallbladder, conversion to open cholecystectomy, reasons for conversion, operating time), postoperative analgesic requirement, length of postoperative stay, and total hospital stay (including the admission at presentation and admission for subsequent delayed surgery in the delayed group) and postoperative complications.

The patients were admitted with a diagnosis of AC and randomly assigned to receive either ELC within 72 h of admission (early group, n=74) or initial conservative treatment with intravenous fluids and antibiotics including ampicillin, gentamicin, and metronidazole, following by DLC 6–12 weeks later after successful nonoperative management (delayed group, n=74).

Criteria of patients with AC include: (a) temperature more than 37.5°C, (b) persistent right upper quadrant abdominal pain and tenderness, (c) leukocytosis (>10 000 cells/mm^3), (d) positive Murphy's sign, and (e) imaging findings as defined by Tokyo guidelines [10] (thickened gallbladder wall, enlarged gallbladder, sonographic Murphy sign, pericholecystic fluid collection, pericholecystic or hepatic abscess, presence of choledocholithiasis). The diagnosis of AC was confirmed by intraoperative findings and pathologic specimens.

Table 1 Patient characteristics

Patient characteristics	Early group (<72 h) (*N*=74)	Delayed group (>72 h) (*N*=74)	*P* value
Sex			
Male	53 (71.6)	51 (68.9)	0.719‡
Female	21 (28.4)	23 (31.1)	
Age (years)			
Mean±SD	41.10±6.96	45.45±7.55	<0.001*
Median (range)	41 (24–58)	46 (32–63)	
Duration of acute symptoms (h)			
Mean±SD	33.44±11.46	84.41±18.13	<0.001●
Median (range)	33 (10–66)	89 (0–100)	
Temperature (°C)			
Mean±SD	38.26±0.23	38.09±0.18	<0.001●
Median (range)	38.20 (37.80–38.80)	38 (37–38.50)	
Murphy's sign			
Negative	0 (0)	1 (1.4)	1.000‡
Positive	74 (100)	73 (98.6)	
Palpable gallbladder			
Absent	50 (67.6)	54 (73)	0.472‡
Present	24 (32.4)	20 (27%)	
Jaundice			
Absent	74 (100)	73 (98.6)	1.000‡
Present	0 (0)	1 (1.4)	
Total leukocyte count (>11 000/ml)			
Absent	25 (33.8)	34 (45.9)	0.131‡
Present	49 (66.2)	40 (54.1)	

Quantitative data were expressed as mean±SD and median (range); qualitative data were expressed as *n* (%). Mann–Whitney *U* test. *Independent samples Student's *t* test. ‡χ^2 test. *P* value less than 0.05 is significant. ●Means that the value is highly significant and calculated by using Mann Whitney U test.

All patients with simple biliary colic, choledocholithiasis, biliary pancreatitis or acute cholangitis, decompensated liver cirrhosis, massive ascites, free biliary perforation, intra-abdominal abscess, a history of previous upper abdominal surgery, chronic obstructive pulmonary disease, ischemic heart disease, cerebrovascular disease, who were already admitted to the ICU on presentation, pregnant women, who chose open cholecystectomy, and who have mental illness prohibiting informed consent were excluded from our study. Before the procedure, fully informed consent was taken for laparoscopic cholecystectomy. Additionally, patients' consent for conversion to an open procedure was obtained.

Laparoscopic cholecystectomy

At anesthesia induction, cefuroxime 1.5 g and ondansetron were used. Heparin was reserved for patients with risks of thromboembolic disease, those who are obese, previous history of deep venous thrombosis, and prolonged preoperative admission. All laparoscopies were performed by a conventional four-trocar operative technique, using a 10-mm optical trocar in the umbilical region, a 10-mm operating trocar in the left subcostal region, a 5-mm operating trocar in the right lower quadrant, and a 5-mm retractor trocar in the epigastric region. The patients were placed in a supine reverse Trendelenburg position with closed legs and mild left lateral rotation. The flow rate was kept at a minimum of around 1.5 l/min. In case of acutely inflamed tense gallbladders, the contents were firstly aspirated using a suction cautery. Calot's triangle is then dissected and the cystic artery is cauterized with bipolar cautery. The cystic duct is divided between ligatures and clips according to the 'critical view of safety' proposed by Strasberg and Brunt [11]. Dissection of the gallbladder from the liver was accomplished by using monopolar electrocautery. Port sites are irrigated regularly.

Special modifications were adopted when considered necessary by the surgeon [12]. These modifications included the use of an additional cannula, sutures to control the cystic duct, endoscopic pouches to retrieve the specimen, enlargement of an umbilical incision to extract the specimen, and placement of closed suction drains in the subhepatic space as shown in Table 3.

The decision to convert to open cholecystectomy, performed through a right subcostal incision was made according to the operative situation including the difficulty of dissection, poor control of intraoperative hemorrhage, and adhesions of Calot's triangle or the liver bed. In almost all cases, a drain was placed in the subhepatic space after a thorough saline

lavage, and it was usually removed in the first postoperative day. Surgical procedures were performed by senior surgeons with experience of more than 100 laparoscopic cholecystectomy.

Patients follow-up

After the surgical procedure, a dedicated nursing staff member looked after the patients for the first 4 h postoperatively. All patients were allowed to eat and drink 6–12 h after surgery, provided they had no nausea or vomiting. Pain relief was obtained by intramuscular diclofenac injection. We routinely use a single dose of co-amoxiclav 1.2 g intravenously. In patients with penicillin allergy, we preferred intravenous ciprofloxacin and metronidazole. Early and delayed complications were considered as indications for hospital admission or readmission, respectively.

The outcome measures were complication rates, mortality rates, length of hospital stay, operating time, conversion rate to an open procedure, beginning of oral feeding, blood loss, and use of subhepatic drains.

Sample size calculation

Power analysis was performed using the χ^2 test for independent samples on frequency of complications. According to the Madan *et al.* [13] study, the frequency of complications was 0% in the early group and 9.7% in the delayed group. At power of 0.8 and an alpha error of 0.05, a minimum sample size of 74 patients was required in each group. A total of 148 patients were included in the study who were randomly allocated between the study arms using physical randomization with balance. MedCalc 13 for Windows (MedCalc Software bvba, Ostend, Belgium).

Statistical analysis

Continuous variables were expressed as the mean±SD and median (range) and the categorical variables were expressed as a number (percentage). Continuous variables were checked for normality by using the Shapiro–Wilk test. Independent samples Student's *t* test was used to compare two dependent groups of normally distributed data while Mann–Whitney *U* test was used for non-normally distributed data. Percent of categorical variables were compared using χ^2 test or Fisher's exact test when appropriate. All tests were two sided. A *P* value less than 0.05 was considered statistically significant. All data were analyzed using the Statistical Package for Social Sciences for Windows, version 20.0 (SPSS Inc., Chicago, Illinois, USA).

Results

During the study period, a total 148 patients were randomized: 74 patients in the early group and 74 patients in the delayed group. Ultrasonographic findings of the patients in the two groups were comparable, as shown in Table 2.

Operative procedures and operating time

More modifications in the operation technique are shown in Table 3 and a longer operation time was required in the early group than in the delayed group. The mean operating time was 126.55 min (range, 50–210 min) in the early group and 109.94 min (range, 40–190 min) in the delayed group. The difference in operation time was not statistically significant (P=0.015). Intraoperative findings and outcome of laparoscopic cholecystectomy are shown in Table 4. The average blood loss was 209 ml (180–295 ml) in the early group and 110 ml (90–295 ml) in the delayed group (P<0.001). No patients in either groups required blood transfusion. The intraoperative blood loss was estimated by measuring suction canisters preoperatively and postoperatively and subtracting the amount of irrigation used from it.

Table 2 Ultrasound findings

Ultrasound findings	Early group (<72 h) (*N*=74)	Delayed group (>72 h) (*N*=74)	*P* value‡
Thickened edematous gallbladder (>4 mm)			
Absent	32 (43.2)	35 (47.3)	0.620
Present	42 (56.8)	39 (52.7)	
Distended gallbladder			
Absent	13 (17.6)	19 (25.7)	0.231
Present	61 (82.4)	55 (74.3)	
Murphy's sign			
Absent	33 (44.6)	26 (35.1)	0.240
Present	41 (55.4)	48 (64.9)	
Pericholecystic fluid			
Absent	63 (85.1)	63 (85.1)	1.000
Present	11 (14.9)	11 (14.9)	

Qualitative data were expressed as *n* (%). ‡χ^2 test; *P* value less than 0.05 is significant.

Table 3 Modification of the operative technique

Modification of the operative technique	Early group (<72 h) (*N*=74)	Delayed group (>72 h) (*N*=74)	*P* value‡
Gallbladder decompression			
Not done	24 (32.4)	70 (94.6)	<0.001
Done	50 (67.6)	4 (5.4)	
Retrieval bag			
Not done	49 (66.2)	71 (95.9)	<0.001
Done	25 (33.8)	3 (4.1)	
Subhepatic drain			
Not done	24 (32.4)	49 (66.2)	<0.001
Done	50 (67.6)	25 (33.8)	
Use of a fifth port			
Not done	67 (90.5)	72 (97.3)	0.166
Done	7 (9.5)	2 (2.7)	
Enlargement of the epigastric port site			
Not done	70 (94.6)	71 (95.9)	1.000
Done	4 (5.4)	3 (4.1)	

Qualitative data were expressed as *n* (%). ‡χ^2 test. *P* value less than 0.05 is significant.

Table 4 Intraoperative findings and outcome of laparoscopic cholecystectomy

Intraoperative findings and outcome of laparoscopic cholecystectomy	Early group (<72 h) (*N*=74)	Delayed group (>72 h) (*N*=74)	*P* value
Operating time (min)			
Mean±SD	126.55±31.96	109.94±39.45	0.015●
Median (range)	131.50 (50–210)	124 (40–190)	
Blood loss (ml)			
Mean±SD	216.17±26.21	133.02±53.42	<0.001●
Median (range)	209 (180–295)	110 (90–295)	
Bile duct injury			
Absent	73 (98.6)	70 (94.6)	0.366‡
Present	1 (1.4)	4 (5.4)	
Transection of Hartmann's pouch			
Absent	73 (98.6)	70 (94.6)	0.366‡
Present	1 (1.4)	4 (5.4)	
Use of drains			
Absent	73 (98.6)	71 (95.9)	0.620‡
Present	1 (1.4)	3 (4.1)	
Ileus			
Absent	73 (98.6)	69 (93.2)	0.209‡
Present	1 (1.4)	5 (6.8)	
Wound infection			
Absent	66 (89.2)	62 (83.8)	0.336‡
Present	8 (10.8)	12 (16.2)	
Conversion rate to open surgery			
Absent	65 (87.8)	57 (77)	0.084‡
Present	9 (12.2)	17 (23)	
Postoperative stay (days)			
Mean±SD	2.83±1.18	7.10±2.73	<0.001●
Median (range)	3 (1–7)	7 (4–19)	
Total hospital stay (days)			
Mean±SD	7.56±1.88	12.77±3.36	<0.001●
Median (range)	8 (2–15)	12 (8–24)	
Loss of active days of work (days)			
Mean±SD	12.40±6.07	20.70±9.31	<0.001●
Median (range)	11 (2–28)	16 (13–39)	
Postoperative analgesia			
Mean±SD	5.68±1.45	8.35±1.96	<0.001●
Median (range)	6 (3–9)	9 (0–11)	

Quantitative data were expressed as mean±SD and median (range). Qualitative data were expressed as *n* (%). ●Mann–Whitney *U* test. ‡χ^2 test. *P* value less than 0.05 is significant.

Complications

There was no death in either group. The overall complication rate was 27% (20 of 74) in the early group and 56.7% (42 of 74) in the delayed group. In the early group, one patient experienced postoperative cholangitis with subsequent cystic duct stump leak, which was treated by endoscopic retrograde cholangiography and stent placement. In the delayed group four patients had a minor bile duct injury at the junction of the cystic duct with the bile duct and this was required conversion and suturing of pinhole rent in the bile duct with a single 4-0 Vicryl stitch. In the early group, there were eight wound infections and a postoperative ileus in one patient, while there was 12 patients with wound infections and five patients with postoperative ileus in the delayed group. All cases with ileus in both groups responded to conservative treatment.

Conversion to open surgery

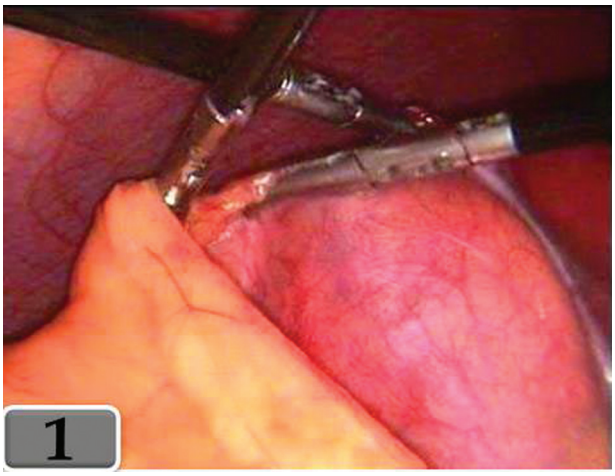
Nine (12.2%) patients in the early group and 17 (23%) patients in the delayed group underwent conversion to open surgery (P=0.084). The main reasons for conversion in the early cases were technical, including one case each of unclear Calot's triangle anatomy, suspicion of bile duct injury, minor bile duct injury, and transection of gallbladder at Hartman's pouch. The main reason for conversion in the delayed group involved dense adhesions around Calot's triangle and gallbladder, making dissection difficult.

Hospital stay

Postoperative hospital stay was considered as the number of days from the date of surgery to hospital discharge which was significantly shorter in the early group (2.83 vs. 7.10) (P<0.001). The total hospital stay was defined as the total number of days of hospitalization required by any patient from the date of emergency-ward admission to final discharge after cholecystectomy. Significantly shorter total hospital stay was observed in the early group (7.56 vs. 12.77) (P<0.001).

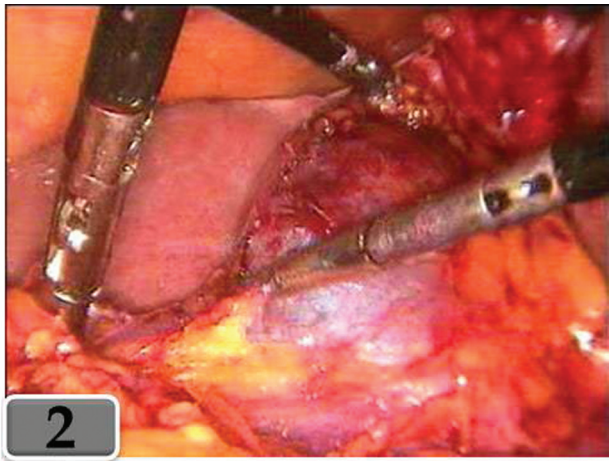
Loss of active days of work (days away from work) for any patient was defined as the total number of days away from work including days of hospitalization (emergency-ward admission and cholecystectomy) till return to work. Data collected during follow-up of the patients postoperatively by asking them about the days they spent at home after discharge and before return to their work. Days away from work were significantly shorter in the early group (12.40±6.07 vs. 20.70±9.31) (P<0.001).

Figure 1



Photograph of laparoscopic cholecystectomy in acute cholecystitis showing: omental adhesion to the gallbladder.

Figure 2



Photograph of laparoscopic cholecystectomy in acute cholecystitis showing: with edematous and distended gallbladder after releasing the adhesions.

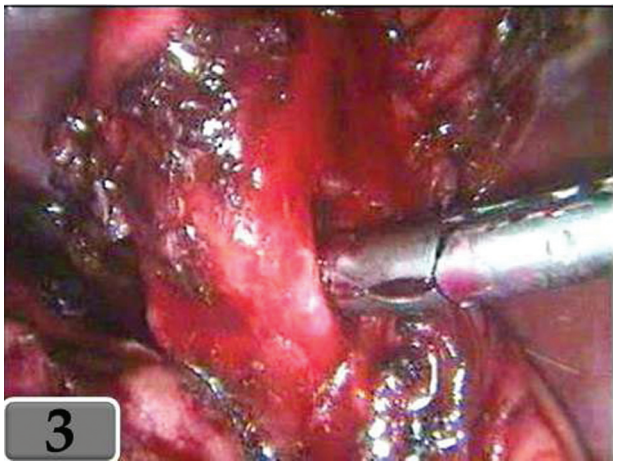
Postoperative pain score and analgesia requirement

The mean duration of postoperative analgesic requirement was 5.6 days in the early group and 8.3 days in the delayed group (Figs 1–4).

Discussion

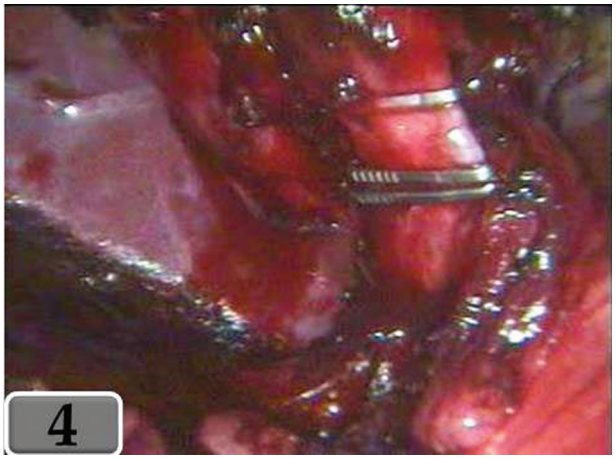
Laparoscopic cholecystectomy is feasible and safe in AC [14]. In the first decade of laparoscopic era, AC was considered a contraindication for a minimally invasive approach, but nowadays, laparoscopic cholecystectomy is indicated as the treatment of choice for patients with AC. Moreover, recently, meta-analyses suggest that ELC is advantageous [15]. Furthermore, in a recent review of the literature, laparoscopy is not associated with an increased risk of postoperative complications [16].

Figure 3



Photograph of laparoscopic cholecystectomy in acute cholecystitis showing: edematous dilated cystic duct.

Figure 4



Photograph of laparoscopic cholecystectomy in acute cholecystitis showing: clipping of the cystic duct.

Therefore, if the experience of the surgeons allows, laparoscopy is acceptable in this setting in spite of a three-fold increased conversion rate [16]. We defined 72 h as the minimum duration of symptoms for inclusion in the study and prospectively evaluated the results of treatment in low-risk patients with AC [17].

In the setting of AC, laparoscopic cholecystectomy is still considered a challenging procedure due to anticipated anatomical difficulties with reported higher incidences of common bile duct injuries [18]. It is proven that ELC (within 72 h) becomes superior to DLC (after a few weeks) in most of the prospective, randomized trials. It is clarified in a shorter hospital stay and a shorter recuperation time while the conversion rate and morbidity remain similar with or even lower than delayed interval LC [19]. The classical treatment modality for patients with late AC admitted later than the 'golden 72 h' is an elective cholecystectomy, performed weeks after strict medical therapy, called 'cool down' [20]. However, more than 20% of these patients failed to respond to the medical management or suffered from recurrent cholecystitis in the interval period, leading to one or more readmissions and to unplanned urgent surgery in more than 50% [20].

Waiting for an inflamed gallbladder to cool down allows maturation of the surrounding inflammation leading to the organization of adhesions that make the dissection more difficult [21]. Bile duct injury was the most important and most severe complication that occurred during the comparisons of LC in early and interval groups [21]. Some surgeons believe that the edema and hyperemia around the gallbladder in early cholecystitis may facilitate dissection [22].

Arguments in favor of early surgery include less technical difficulties, arrest of disease, and less complications [23]. Banz *et al.* [24] have reported that the delay in performance of cholecystectomy led to higher conversion rates, more postoperative complications, and significantly longer hospital stay. Conversely, other authors have underlined deceiving results of early surgery: more morbidity, in particular in patients with symptoms longer than 48–72 h [24]. A successful laparoscopic cholecystectomy is associated with a less painful postoperative course, with low analgesic requirement and a short hospital stay [25].

Most studies have claimed an increased operating time of 10–30 min for emergency cholecystectomy compared with elective surgery [26]. On the other hand, another study [27] suggested that patients undergoing ELC for AC suffered the highest conversion and complication rates, whereas elective surgery was superior. Gallbladder wall thickness, presence of adhesions, and liver and gallbladder sizes have been recognized as factors associated with high operative intricacy and conversion [28]. In the setting of AC, greater age, a history of previous biliary disease, the finding of a nonpalpable gallbladder, leukocytosis, and gangrenous cholecystitis are all associated with higher conversion rates [29]. Table 5 summarizes the findings of several of the publications on the topic.

Recently, Willsher *et al.* [34] also found an association between a delay in surgery and conversion from LC to open cholecystectomy. Lai *et al.* [31] and Lo *et al.* [25] compared patients who were operated on during the acute phase of AC with those operated on at a later

stage, following recovery from the acute stage, as an interval procedure. Both studies found that ELC was associated with a longer operative time and a prolonged hospital stay, but with comparable conversion and complication rates.

Table 5 Summary of findings of laparoscopic cholecystectomy in acute cholecystitis

References	Number of patients	Important findings
Chandler *et al.* [22]	43	Early (surgery ASAP) versus late (up to 5 days after admission) was associated with reduced operative time, lower conversion rate, lower estimated blood loss, shorter hospital stay, and lower hospital charges. No difference in complications
Rattner *et al.* [30]	281	Early surgery was associated with a lower conversion rate, shorter operative time, shorter hospital length of stay. Ultrasound findings of thickened gallbladder wall and pericholecystic fluid did not correlate with either success or failure of laparoscopic cholecystectomy
Lai *et al.* [31]	104	No difference in conversion rate, postoperative analgesic requirements, or complications. Early group had longer operative time and shorter hospital stay
Brodsky *et al.* [32]	215	The only controllable factor related to conversion rate was duration of disease. Earlier operation was associated with lower conversion rate
Eldar *et al.* [33]	130	Early (<96 h) surgery had a conversion rate of 23%. Late (>96 h) surgery had a conversion rate of 47%
Willsher *et al.* [34]	152	Conversion less likely in patients having surgery within 2 days of admission
Koo *et al.* [8]	60	Early operation (<72 h from onset of symptoms) was associated with a lower conversion rate, shorter operation, lower hospital charges, and shorter convalescence
Lo *et al.* [35]	99	Early operation (>72 h from admission) was associated with a lower conversion rate and lower complication rate

Table 6 shows comparison of results of laparoscopic cholecystectomy for AC in the literature. A retrospective study [30] also found that the risk of postoperative infections increased with the length of delay to surgery. Moreover, our study showed that the risk of wound infection was lower in the ELC group.

Conclusion

From our study, we can conclude that the ELC is safe and is associated with improved outcomes across many domains. ELC seems to be the treatment of choice for patients with AC by surgeons with experience, not only in laparoscopic cholecystectomy, but also in open surgery.

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Conflicts of interest

There are no conflicts of interest.

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Table 6 Outcome of laparoscopic cholecystectomy for acute cholecystitis: comparison of results in the literature

References	Number of patients	Mean age (years)	Conversion rate (%)	Operative time (min)	Intraoperative cholangiogram (%)	Morbidity (%)	Postoperative hospital stay (days)
Rattner *et al.* [30]	20	57.0	35	87	–	7.1	2
Miller and Kimmelstiel [36]	29	50.0	14	–	–	10.3	2.6
Zucker *et al.* [12]	83	52.2	27	128	93.5	14.8	3.3
Wiesen *et al.* [37]	100	54.8	8	94	66.3	17	2.4
Velasco *et al.* [38]	27	60.4	7.4	121	92.6	11	1.9
Hawasli [39]	54	55.3	3.7	81.4	–	5.6	2.7

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