ORIGINAL ARTICLE

Early and Delayed Laparoscopic Cholecystectomy in Acute Calculus Cholecystitis: A Prospective Randomized-comparative Study

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Abstract

Background: Acute cholecystitis is a very common gastrosurgical emergency. The timing of laparoscopic cholecystectomy (LC) in cases of acute cholecystitis is still a matter of debate. In general, delayed LC is preferred because of higher morbidity and conversion rate when LC is performed in acute cholecystitis.

Aim and objective: To compare the various parameters and outcomes between early and delayed laparoscopic cholecystectomies with safety and feasibility evaluation.

Materials and methods: A prospective, randomized controlled, interventional study was conducted from October 2017 to February 2019. Patients with a diagnosis of acute cholecystitis post-randomization were assigned into the early group ($n = 50$; LC within 72 hours of admission) and the delayed group ($n = 50$; initial conservative treatment followed by delayed LC 6–12 weeks later). The primary outcome measures were intraoperative and postoperative complications (bile duct injuries, bile leak, and wound infection), morbidity, mortality conversion, and length of hospital stay. The secondary outcome measures were the mean duration of surgery, the mean blood loss, other complications (subhepatic collection, postoperative pneumonia), and unsuccessful nonoperative management.

Results: In our study, the conversion rate in early laparoscopic cholecystectomy (ELC) group was 5 (10%) and delayed laparoscopic cholecystectomy (DLC) group was 7 (14%), respectively. The mean operative time was 77.30 ± 20.078 vs 66.94 ± 29.501 minutes; $p < 0.001$ in ELC and DLC groups, respectively; the mean blood loss was 82.60 ± 59.67 vs 65.40 ± 74.21; $p < 0.007$ in ELC and DLC groups, respectively. Postoperative complication was 4 (8%) vs 7 (14%) for ELC and DLC groups, respectively. However, the patients in the ELC group had a significantly shorter hospital stay (4.46 ± 1.32 vs 6.0 ± 2.54 days; $p < 0.002$).

Conclusion: Early cholecystectomy is safe and feasible in patients with acute cholecystitis. Early cholecystectomy offers definitive treatment as it eliminates risks of failed conservative management and repeated episodes of acute cholecystitis with the advantage of shorten mean hospital stay without increased morbidity and mortality.

Keywords: Acute cholecystitis, Cholecystectomy, Early cholecystectomy, Laparoscopic.

World Journal of Laparoscopic Surgery (2021): 10.5005/jp-journals-10033-1465

Introduction

For symptomatic cholelithiasis, laparoscopic cholecystectomy (LC) is a gold standard treatment. The timing of LC in acute calculus cholecystitis is still a matter of considerable debate and related controversies. Before the laparoscopic era, randomized studies revealed that the strategy of early open cholecystectomy within 7 days of the onset of symptoms was preferred as it provided shorter hospital stay and reduced potential risk of complications, such as pancreatitis, gangrenous, or emphysematous cholecystitis, without an increase of postoperative morbidity and mortality.[1,2]

Till 1990, acute cholecystitis was considered as a contraindication for LC due to increased postoperative morbidity, longer operative time, and higher conversion rate.[3,4] Consequently, delayed LC (DLC) was preferred after conservative medical treatment on the assumption that inflamed tissue is more vulnerable to laparoscopic intervention and may increase the risk of complications. In the last 15–20 years, as the surgeons excelled in laparoscopic surgeries, with improvement in laparoscopic devices and instruments, even acute cases were considered for LC. Randomized trials and meta-analysis have demonstrated that there was no difference in early LC (ELC) and DLC groups in terms of conversion rate, bile duct injuries, postoperative morbidity, and mortality. Moreover, the ELC group has reported the significantly shortened hospital stay and incurred low cost.[5]

Despite the evidence, DLC is still preferred in clinical practices due to controversial timings for LC in cases of acute cholecystitis.[6,7]

The aim of this study was to compare various parameters and outcomes between ELC and DLC with safety and feasibility evaluation. Outcomes were compared in terms of operative time, intraoperative and postoperative complications, length of postoperative, and total hospital stay between ELC and DLC groups.

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How to cite this article: Lal S, Rohitaj R, Najim Md, *et al*. Early and Delayed Laparoscopic Cholecystectomy in Acute Calculus Cholecystitis: A Prospective Randomized-comparative Study. World J Lap Surg 2021;14(3):149–156.

Source of support: Nil

Conflict of interest: None

Material and Methods

Patients and Methods

This study was a prospective randomized interventional study conducted in the Department of Surgery, at Postgraduate Institute of Medical Sciences and Research and Employee State Insurance Corporation Model Hospital, New Delhi, India from October 2017 to February 2019 after approval from the institutional ethical committee. Written and informed consent was obtained from each patient for inclusion in the study, LC, and conversion to open.

Inclusion Criteria

Acute cholecystitis patients admitted to the Department of Surgery of age from 18 to 60 years of either sex, with the American Society of Anesthesiologists (ASA) grade I and II, were included. Right upper abdominal pain, temperature more than 98.6°C, total leukoctes counts (TLC) more than 10,000/dL, or both, and presence of gallstones, thickened and edematous gallbladder (GB) wall with pericholecystic fluid were considered as diagnostic criteria. Finally, intraoperative findings were reckoned as diagnostic for acute cholecystitis.

Exclusiosn Criteria

Exclusion criteria included patients with simple biliary colic, obstructive jaundice, choledocholithiasis, gallstone-induced acute pancreatitis, post-endoscopic retrograde cholangiopancreatography, previous biliary tract surgery, previous abdominal surgery, biliary peritonitis, decompensated liver cirrhosis, intra-abdominal abscess, GB polyp, or malignancy, ASA grade III and IV, refusal of surgery, acute cholecystitis in pregnancy, and other contraindication to surgery.

Sample Size Calculation

Sample size calculation was done on the basis of the study of Gutt et al.[8] in which the overall complications were 14.1 and 40.4% in early group and delayed group, respectively. Considering the 80% power and 5% level of significance, the minimum number of patients required was 40 in each group. The sample size was increased by 10% on the basis of the assumption of nonparametric statics and dropout, and finally we consider 50 patients in each group.

Randomization

Block randomization with a sealed envelope system was used. We prepared randomly generated ten opaque sealed envelopes assigning A and B in five blocks each: A represented the ELC group and B represented the DLC group. Patients who underwent LC within 72 hours of symptoms were included in the ELC group, whereas LC done after 6–12 weeks were included in the DLC group. These patients were initially managed conservatively (broad-spectrum intravenous antibiotics and intravenous fluid resuscitation) and discharged when asymptomatic.

Data Collection

Data were collected from the index admission of patients, which included age, sex, associated comorbidities, BMI, past history of biliary disease, history of previous abdominal surgeries, duration of symptoms, and clinical examination. Other data included were laboratory, radiological, intraoperative, and postoperative parameters.

LC was performed by conventional four ports operative technique. Certain modifications were done as and when required, like GB decompression, use of laparoscopic specimen retrieval bag, epigastric port enlargement, suction/irrigation, and subhepatic closed suction drain placement.

Conversion to open cholecystectomy was done through right subcostal incision during difficulty in dissection, excessive bleeding, and adhesion of Calot's triangle. The drain was removed after 24–72 hours postoperatively. Surgical procedures were performed by surgeons having more than 5 years of experience of LC in a single surgical unit. All patients were allowed to eat and drink 6–8 hours postsurgery, in the absence of nausea or vomiting. Intramuscular diclofenac injection was advised for pain relief. Antibiotics were prescribed as per hospital protocol.

Primary outcome measures were conversion to open surgery, mean duration of hospital stay, complications (bile leak, bile duct injuries, and postoperative wound infection), and mortality. The secondary outcome measures were the mean duration of surgery, intraoperative blood loss, other complications (subhepatic collection, postoperative pneumonia), and unsuccessful nonoperative management.

Statistical Analysis

The data were entered in an Excel spreadsheet and analyzed by the Statistical Package for Social Sciences (SPSS) version 21.0. Categorical variables were presented in number and percentage (%). Continuous variables were presented as mean ± standard deviation (SD) and median. Normality of data was tested by the Kolmogorov–Smirnov test. Quantitative variables were compared using the unpaired *t*-test/Mann–Whitney test while qualitative variables were compared using the Chi-square test/Fisher's exact test. A p value of <0.05 was considered statistically significant.

Results

A total of 145 concordant patients were assessed for the study, out of which 45 patients were excluded as per criteria (Flowchart 1). The comparison group had 50 patients each with post-randomization at the final analysis. As shown in Table 1, both groups were comparable and equally distributed in respect of age, sex, body mass index, laboratory reports, radiological parameters, and comorbidities. There was no failure of conservative treatment in the delayed group which required urgent surgery. Various parameters were observed and evaluated pre-, intra-, and postoperatively.

The physical examination findings were similar in comparison groups. The pain duration, first symptoms, and previous biliary symptoms were comparable in both the groups. The use of antibiotics was significantly more common in the DLC group (49; 98%) as compared to the ELC group 5 (10%); $p < 0.001$. All patients had pain in right hypochondrium. Murphy's sign was positive in 45 (90%) and 40 (80%) of ELC and DLC groups, respectively. Laboratory findings, viz TLC, Kidney function test (KFT), and liver function test (LFT), were comparable in both the groups (Table 1). The ultrasound findings were also comparable in both the groups (Table 2).

The mean intraoperative time and the mean intraoperative blood loss were significantly higher in the ELC group. The mean operative time was 77.30 ± 20.078 vs 66.94 ± 29.501 minutes; ($p < 0.001$) and the mean blood loss 82.60 ± 59.67 vs 65.40 ± 74.21 mL; ($p < 0.007$) in ELC and DLC groups, respectively. No patients in the comparison groups required blood transfusion.

Conversion to open cholecystectomy and achievement of critical view of safety were comparable in both the groups. The adhesion in Calot's triangle, adhesion with the inferior surface of the liver, tensely distended GB, and mucocele/pyocele were more common in the ELC group ($p < 0.010$) (Table 3).

Flowchart 1: Consort flow diagram of the various stages of trial

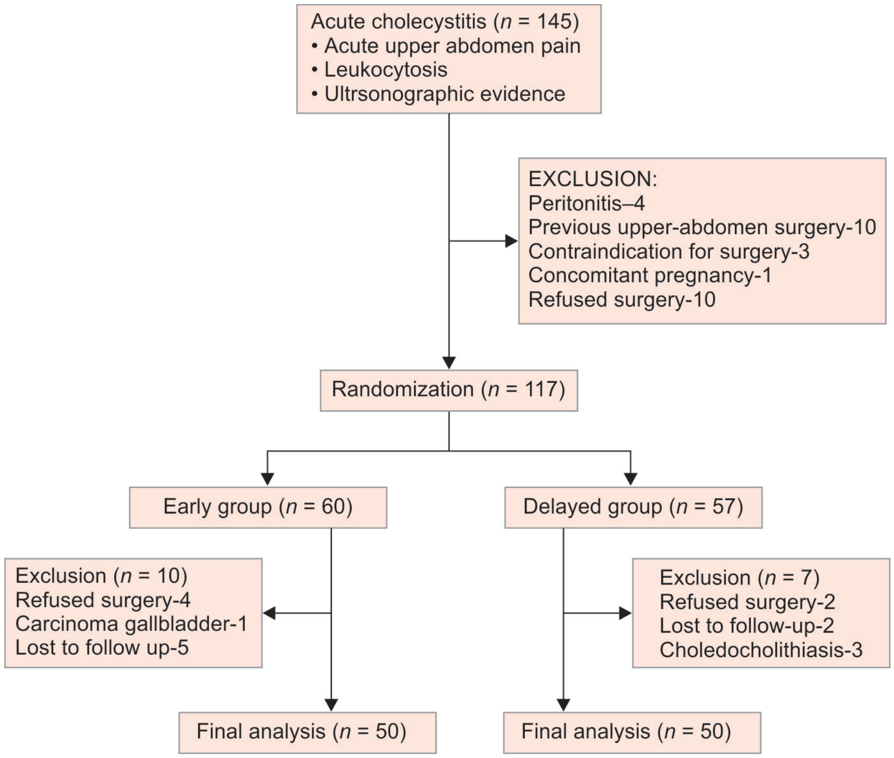

Table 1: Clinical data and laboratory results of patients

Variables	*ELC group (N = 50)*	*DLC group (N = 50)*	*p value*
Age (mean), years	41.0 ± 12.29	38.04 ± 11.38	0.195
Sex: Male	8 (16)	10 (20)	0.603
Female	42 (84)	40 (80)	
BMI (kg/m^2)	23.38 ± 2.72	22.93 ± 2.78	0.414
ASA	I/II	I/II	—
Clinical feature			
Pain duration, mean (hours)	25.0 ± 9.539	23.24 ± 7.305	0.199
Frist attack	34 (68)	36 (72)	—
Previous biliary symptoms	16 (32)	18 (36)	0.673
Previous antibiotics administration	5 (10)	49 (98)	<0.001
Temperature ($^{\circ}$F), mean	99.8 ± 0.1	99.9 ± 0.2	0.612
Nausea/vomiting	49 (98)	49 (98)	1.00
RHC pain	50 (100)	50 (100)	1.00
Murphy’s sign	45 (90)	40 (80)	0.161
Laboratory finding			
Hemoglobin gm/dL	12.886 ± 1.15	12.45 ± 1.17	0.543
White blood cells(N*10^3)	13.04 ± 2.59	12.20 ± 2.49	0.194
Serum bilirubin(mg/dL)	0.867 ± 0.22	0.740 ± 0.14	0.392
SGOT (IU/L)	46.66 ± 18.28	36.96 ± 11.41	0.090
SGPT (IU/L)	47.92 ± 19.97	38.16 ± 14.14	0.071
ALP (IU/L)	215.38 ± 90.07	179 ± 52.98	0.065
Serum amylase (IU/L)	55.16 ± 22.12	36.58 ± 8.79	0.081
Comorbidities			
Diabetes mellitus	3 (6)	3 (6)	0.648
Hypertension	5 (10)	6 (12)	
COPD	1 (2)	1 (2)	
Hypothyroidism	1 (2)	2 (4)	

RHC, right hypochondrium; Figure in parentheses denotes percentage

Table 2: USG findings for the patients

Characteristics/parameters	*ELC group (n = 50)*	*DLC group (n = 50)*	*p value*
Gallstones: Single	7 (14)	5 (10)	0.538
Multiple	43 (86)	45 (90)	
Thickened GB	48 (96)	42 (84)	0.840
Distended GB	46 (92)	47 (94)	0.768
Pericholecystic fluid	22 (44)	20 (40)	0.536
Murphy's sign	45 (90)	46 (92)	0.167

Table 3: Intraoperative findings, modification, and complications

	ELC group (n = 50)	*DLC group (n = 50)*	*p value*
Intraoperative finding			
Mean operative time (minute)	77.30 ± 20.078	66.94 ± 29.501	<0.001
Mean blood loss (mL)	82.60 ± 59.67	65.40 ± 74.21	0.007
Conversion to open Cholecystectomy	5 (10)	7 (14)	0.538
Critical view of safety achieved			0.452
Yes	45 (90)	43 (86)	
No	5 (10)	7 (14)	
Adhesion in Calot's triangle	39 (78)	24 (48)	0.010
Adhesion with inferior surface of liver	24 (48)	7 (14)	
Tensely distended gallbladder (GB)	36 (72)	14 (28)	
Contracted GB	0 (0)	6 (12)	
Turbid bile	8 (16)	3 (3)	
Perforated GB	2 (4)	0 (00)	
GB gangrene	3 (6)	0 (00)	
Mucocele/pyocele	32 (64)	10 (20)	
Operative modifications			
GB decompression	40 (80)	20 (40)	<0.001
Endo-bag retrieval of GB	19 (38)	9 (18)	0.026
Epigastric port enlargement	10 (20)	11 (22)	0.806
Suction/irrigation	44 (88)	23 (46)	<0.001
Subhepatic drain	40 (80)	21 (42)	<0.001
Intraoperative complications			
Spillage of bile/stone	4 (8)	3 (6)	0.583
GB perforation	3 (6)	2 (4)	
Cystic artery bleeding	3 (6)	6 (12)	
Liver bed bleeding	00	1 (2)	
Accessory bile duct leak	00	1 (2)	
Bowel injury	00	1 (2)	

More operative modifications were required in the ELC group, viz GB decompression, laparoscopic bag retrieval of a specimen, suction/irrigation, and subhepatic drain placement. No significant difference was noted in both the groups with intraoperative complications, like bile/stone spillage, GB perforation, and cystic artery bleed. No bile duct injury occurred in both the groups. One patient in the DLC group had an accessory bile duct leak, which was identified by magnetic resonance cholangiopancreatography and managed conservatively (Table 3).

Multiple causes were found in both the groups for conversion as shown in Table 4, which were comparable and statistically not significant. Cholecysto-colonic fistula and Mirizzi syndrome were found in one patient of the DLC group.

Total hospital stay was 4.46 ± 1.32 vs 6.0 ± 2.83 days in ELC and DLC groups, respectively. The difference was statistically significant $p < 0.002$. Statistically no difference was found in subhepatic drain duration and postoperative hospital stay. The requirement of postoperative analgesia and use of antibiotics were comparable in both the groups. The postoperative complications in terms of pulmonary, wound infections, intra-abdominal infections, and bile leak were similar in both the groups (Table 5). Feature of acute cholecystitis on histopathological examination was more prevalent in the ELC group ($p < 0.001$) (Table 6).

Discussion

On ultrasound screening, gallstones are found in 5 to 20% of the adult population.[9] The gallstone-related complications, such as acute cholecystitis, develop in 1 to 4% of patients.[10] Acute cholecystitis is the most frequent cause for hospitalization among

Table 4: Causes of conversion to open cholecystectomy

Cause	*ELC group (n = 5)*	*DLC Group (n = 7)*	*p value*
Dense adhesion	5 (10)	6 (12)	0.567
Difficulty in identifying Calot's	4 (8)	6 (12)	0.800
Bleeding	5 (10)	6 (12)	0.567
Technical difficulty	4 (8)	6 (12)	0.800
Cysto-colonic fistula	0	1 (2)	—
Mirizzi syndrome	0	1 (2)	—

Table 5: Postoperative variables and complications

Variables	*ELC group*	*DLC group*	*p value*
Postop hospital stay (days)	1.96 ± 1.24	2.46 ± 2.54	0.768
Total hospital stay (days)	4.46 ± 1.32	6.0 ± 2.83	0.002
VAS			
Day 1	3.60 ± 0.67	3.74 ± 0.52	0.262
Day 2	1.32 ± 0.86	1.40 ± 0.96	0.674
Postoperative analgesia			
12 hours	42 (84)	46 (92)	0.498
24 hours	15 (30)	19 (38)	
Duration of antibiotics (days)	2.98 ± 2.93	2.90 ± 3.3	0.661
Complications *N* (%)			
Pulmonary complications	1 (2)	3 (6)	
Bile duct injuries	00	00	
Wound infections	2 (4)	3 (6)	0.423
Intra-abdominal infections	1 (2)	00	
Bile leak	00	1 (2)	

Table 6: Gallbladder histopathology

	ELC group N = 50 (%)	*DLC group N = 50 (%)*	*p value*
Acute gangrenous cholecystitis	4 (8)	0	
Acute cholecystitis	25 (50)	0	
Acute on chronic cholecystitis	14 (28)	3 (6)	<0.001
Chronic cholecystitis	7 (14)	47 (94)	
Total	50 (100)	50 (100)	

all gastrointestinal diseases.[11] For symptomatic cholelithiasis, LC is "the gold standard" for definite treatment. LC in acute cholecystitis is still considered a challenging procedure due to anticipated anatomical difficulties. Traditionally, elective cholecystectomy is preferred after weeks of strict medical therapy, called "cool down". In the interval period, more than 20% of these patients do not respond to medical treatment or develop recurrent cholecystitis. This leads to multiple readmission and emergency surgery in more than 50% of patients.[12]

For good outcomes, "the timing of surgery" is of great significance. Preferably, the surgery should be performed promptly after the presentation at hospital. The norm of early surgery within golden 72 hours of symptoms in acute cholecystitis has been advocated, which has been proven safe and feasible.[13,14]

Merely, such early surgery in clinical practice is not always possible due to logistic difficulties and the availability of experienced surgeons in an emergency. The timing for surgery in the early group varies from 72 hours to 7 days, whereas it may vary from 6 to 12 weeks in the delayed group We performed LC in the ELC group within 72 hours of symptoms whereas in the DLC group, 6–12 weeks after the symptoms. The bile duct injury remains the most important entity for comparison of the outcome, safety, and feasibility of the study.

The rates of minor bile duct injury and major bile duct injury after laparoscopic surgeries are 0.1–1.7% and 0.1–0.9%, respectively.[15] Well-known risk factors for bile duct injuries are obesity, local inflammation, and perioperative bleeding.[15] No patient in our study had bile duct injury.

Similar findings were reported by Kolla et al.,[16] Gul et al.,[17] Sánchez-Carrasco et al.[18] The meta-analysis by Menahem et al. suggested that the rate of major bile duct injury was insignificant in both ELC and DLC groups [2/247, 0.8% vs 2/223, 0.9%; relative risk (RR), 0.96; 95% confidence interval (CI), 0.25–3.73; $p = 0.950$].[15] Similarly, Skouras et al.[19] found no significant difference in the incidence of postoperative complications and the bile duct injury ratio (0.5% for the ELC group vs 1.4% for the DLC group; $p = 0.54$).[19]

In our study, the mean blood loss was significantly more in ELC than DLC group, because of inflammatory reactions leading to neovascularity, adhesions around GB, and Calot's triangle in the acute phase of acute cholecystitis (82.60 ± 59.67 vs 65.40 ± 74.21 mL; $p < 0.007$). However, no patient required blood transfusion. Similarly, recent studies reported more blood loss in the ELC group.[17,18]

The higher conversion rate obviates the advantage of ELC. However, various meta-analysis of randomized studies showed that conversion to open surgery in ELC and DLC groups ranged from 12.7 to 20.7% and from 13.9 to 23.6%, respectively.[15,20–23]

There were different reasons for conversions in the comparison groups:

ELC group: The edematous, friable, and distended GB perforated when grasped and bleeding.

DLC group: Contracted GB, dense adhesions, and difficult exposure obscured the Calot's triangle due to chronic inflammation.[24] Our study found the conversion rate 5 (10%) and 7 (14%) in ELC and DLC groups, respectively.

The increased duration of operation from 10 to 30 minutes for the ELC group as compared to the DLC group was demonstrated in studies.[15,17,19,25–29] We found the duration of operation was 77.30 ± 20.07 and 66.94 ± 29.5 minutes in ELC and DLC groups, respectively ($p < 0.001$). The significant increased operative time in the ELC group was due to inflammation, edema, thickened and distended GB, adhesions, and bleeding, which required more operative modifications. The most common technical modifications included the following: (i) GB decompression to facilitate better grasping and exposure of Calot's triangle. (ii) The liberal use of suction and irrigation devices required for dissection and control of bleeding. (iii) The use of laparoscopic specimen retrieval bag for stone and GB extraction to avoid port-site infections.[16,26] Reversely, Abdelkader and Ali,[27] Kohga et al.,[25] and Chhajed et al.[30] have demonstrated that the DLC group had more operative time (Table 7). The increased operative time in the DLC group may be because of maturation of the surrounding inflammation leading to fibrosis, dense adhesions, and scaring and contracted GB, which makes dissection difficult.

The requirement of subhepatic drain was more common in the ELC group due to inflammation and exudates. The placement of postoperative drainage tube was significantly more frequent in ELC group than DLC group as demonstrated by Menahem et al.[15] [77.8 vs 37.3%; odds ratio (OR), 6.18; 95% CI, 3.19–11.99; $p < 0.001$].[15] In our study, the subhepatic drain required was 40 (80%) and 21 (42%) in ELC and DLC groups, respectively ($p < 0.001$).

The risk of postoperative wound infection varies in studies. The risk of postoperative infection was twice as high in the DLC group as in the ELC group, as reported by Sánchez-Carrasco et al.[18] (OR = 1.98; 95% CI 1.78–2.17; $p < 0.05$),[18] whereas Gurusamy et al.[21] reported a higher proportion of infections in the ELC group. We found that the wound infection was comparable in both the groups ($p = 0.423$).

The overall complication rates were significantly less in the ELC group or comparable with the DLC group as in various studies (Table 8). A meta-analysis suggests that overall morbidity was statistically insignificant in both groups.[15,19,28]

Our study indicates that the DLC group had a higher rate of overall complications than the ELC group. However, these complications were minor and statistically insignificant ($p = 0.423$). The comparison groups had no mortality. The ELC group has a significantly lower mean total length of hospital stay as compared to the DLC group. Skouras et al. reported that the

Table 7: Outcome of laparoscopic cholecystectomy for acute cholecystitis: comparison of results in the literature

Authors	Study design	N (ELC/DLC)	Age (year) (mean ± SD, range)		Mean duration of surgery (minutes) (mean ± SD, range)		Blood loss (mL) (mean)		Conversion N (%)		Total hospital stay (days)	
			ELC group	*DLC group*	*ELC group*	*DLC group*	*ELC group*	*DLC group*	*ELC group*	*DLC group*	*ELC group*	*DLC group*
Kolla et al.[16]	Pros/Rct	20/20	41.5 ± 11.4	38.6 ± 11.4	104.3 ± 44	93.0 ± 45	228.5 ± 142	114.5 ± 92	5 (25)	5 (25)	4.1 ± 8.6	10.1 ± 6.1
Gul et al.[17]	Pros/Rct	30/30	—	—	98.83	80.67	173.33	101.0	3 (10)	4 (13.33)	—	—
Gutt et al.[8]	Pros/Rct	304/314	55.6 ± 16.3	56.8 ± 17.1	—	—	—	—	30 (9.9)	33 (11.9)	5.4 (4–6)	10.03 (7–12)
Ozkardes et al.[32]	Pros/Rct	30/30	58.0 ± 10.4	59.43 ± 16.60	67.0 ± 28.51	71.33 ± 24.06	—	—	4 (13.3)	0 (00)	—	—
Agrawal et al.[35]	Pros/Rct	50/50	47.28 ± 14.5	50.96 ± 17.0	69.4 ± 29.59	66.4 ± 15.97	159.6 ± 58.11	146.8 ± 52.69	4 (16)	2 (8)	4.16 ± 1.21	8.6 ± 2.04
Roulin et al.[31]	Pros/Rct	42/44	55.8 ± 16.8	57.9 ± 16.6	91 (70–114)	88 (71–118)	—	—	1 (2.4)	0 (0)	4 (3–4)	7 (5–11)
Abdelkader and Ali[27]	Retro	50/50	40.4 ± 13.6	41.2 ± 13.9	85.1 ± 25.08	110.4 ± 21.4	83.8 ± 8.9	90.4 ± 46.3	1 (2)	3 (6)	5.24 ± 1.66	9.6 ± 3.69
Kohga et al.[25]	Retro	288/177	65.5 ± (25–92)	69 (23–96)	105 (47–279)	124 (50–296)	—	—	4 (1.3)	19 (10.7)	—	—
Chhajed et al.[30]	Pros/Rct	30/20	44.2 ± 11.4	39.5 ± 11.7	69.3 ± 15.3	108.5 ± 16.9	—	—	0 (00)	5 (25)	4.9 ± 2.1	7.4 ± 1.8
Arafa et al.[26]	Pros/Rct	74/74	41.1 ± 6.9	45.45 ± 7.5	126.55 ± 31.96	109.94 ± 39.45	216.17 ± 26.12	133.2 ± 53.42	9 (12)	17 (23)	7.56 ± 1.88	12.77 ± 3.36
Present study	Pros/Rct	50/50	41.02 ± 12.39	38.04 ± 11.83	77.30 ± 20.07	66.94 ± 29.50	82.60 ± 59.67	65.40 ± 74.21	5 (10)	7 (14)	4.46 ± 1.32	6.0 ± 2.83

Pros, prospective; RCT, randomized controlled trial; Retro, retrospective

Table 8: Comparison the complications of various studies

				Overall complications, N (%)		
Study	*Year*	*Study design*	*No. of patients (ELC/DLC)*	*ELC group*	*DLC group*	*p value*
Kolla et al.[16]	2004	Pros/RCT	20/20	4 (20)	3 (15)	0.456
Gul et al.[17]	2013	Pros/RCT	30/30	6 (20)	4 (12)	0.863
Gutt et al.[8]	2013	Pros RCT	304/314	43 (14.1)	127 (40.4)	<0.001
Ozkardes et al.[32]	2014	Pros/RCT	30/30	8 (26.7)	0 (0)	0.002
Agrawal et al.[35]	2015	Pros/RCT	50/50	8 (32)	2 (8)	0.353
Roulin et al.[31]	2016	Pros/RCT	41/41	6 (14.6)	8 (19.4)	1.000
Kohga et al.[25]	2018	Retro	288/177	14 (4.8)	23 (12.9)	0.001
Chhajed et al.[30]	2018	Pros/RCT	30/20	1 (3.3)	5 (25)	0.007
Arafa et al.[26]	2019	Pros/RCT	74/74	20 (27)	42 (56.7)	<0.001
Present study	2019	Pros/RCT	50/50	11 (22)	14 (28)	0.583

median total length of hospital stay was shorter in ELC group by 4 days (p <0.001).[19] Further, Menahem et al.[15] found that the mean total length of hospital stay was 5.4 vs 9.1 days in ELC and DLC groups, respectively (p <0.001).[15] Repeated admission for recurrent symptoms and a higher rate of conversion have led to more hospital stays. Studies showed that the total hospital stay was more in DLC group, except in the studies of Kolla et al.[16] and Roulin et al.[31] (Table 7). We found that the mean total hospital stay was comparatively less in ELC group as compared to DLC group for acute cholecystitis (p <0.002).

Studies showed that ELC was more economical and resulted in a better quality of life.[32–34] This may be due to shorter hospitalization and devoid of conservative treatment in the ELC group. We are working in the government-funded hospital; the cost of treatment was therefore not assessed as it was free.

Moreover, meta-analysis of recent randomized studies points toward decreased incidence of postoperative wound infection, shorten total hospital stay, incurred low cost, increased mean duration of surgery, patient's satisfaction, quality of life, and decreased lost working days in the ELC group. Furthermore, no differences in bile leakage, bile duct injuries, morbidity, and conversion to open surgery were reported.[22,23,28]

Conclusion

ELC in acute cholecystitis is safe and feasible in comparison to elective cholecystectomies. ELC avoids recurrent symptoms due to multiple episodes of acute cholecystitis and is a definite treatment for cholecystitis in failed conservative management Moreover, ELC is more advantageous as it provides patients safety and lesser hospital stay. It has economic benefits due to lesser morbidity and mortality.

Acknowledgment

Authors gratefully acknowledge the help of Dr Subhajeet Dey, Dir. Professor of Surgery, ESI-PGIMSR and Model Hospital, Basaidarapur, New Delhi, in the revision of this manuscript by doing peer review and valuable suggestions.

References

1. Järniven HJ, Hästbacka J. Early cholecystectomy for acute cholecystitis. A prospective randomized study. Ann Surg 1980;191(4):501–505. DOI: 10.1097/00000658-198004000-00018.
2. Norrby S, Herlin P, Holmin T, et al. Early or delayed cholecystectomy in acute cholecystitis? A clinical trial. Br J Surg 1983;70(3):163–165. DOI: 10.1002/bjs.1800700309.
3. Wilson P, Leese T, Morgan WP, et al. Elective laparoscopic cholecystectomy for "allcomers". Lancet 1991;338:795–797. DOI: 10.1016/0140-6736(91)90674-e.
4. Kum CK, Eypasch E, Lefering R, et al. Laparoscopic cholecystectomy for acute cholecystitis: is it really safe? World J Surg 1996;20(1):43–48. DOI: 10.1007/s002689900008.
5. Macafee DAL, Humes DJ, Bouliotis G, et al. Prospective randomized trial using cost–utility analysis of early versus delayed laparoscopic cholecystectomy for acute gallbladder disease. Br J Surg 2008;95(Suppl. 3):35. DOI: 10.1002/bjs.6685.
6. Yamashita Y, Takada T, Hirata K. A survey of the timing and approach to the surgical management of patients with acute cholecystitis in Japanese hospitals. J Hepatobiliary Pancreat Surg 2006;13(5):409–415. DOI: 10.1007/s00534-005-1088-7.
7. Casillas RA, Yegiyants S, Collins JC. Early laparoscopic cholecystectomy is the preferred management of acute cholecystitis. Arch Surg 2008;143(6):533–537. DOI: 10.1001/archsurg.143.6.533.
8. Gutt CN, Encke J, Koninger J, et al. Acute cholecystitis: early versus delayed cholecystectomy, a multicentre randomized trial (ACDC study, NCT00447304). Ann Surg 2013;258(3):385–393. DOI: 10.1097/SLA.0b013e3182a1599b.
9. Shaffer EA. Gallstone disease: epidemiology of gallbladder stone disease. Best Pract Res Clin Gastroenterol 2006;20(6):981–996. DOI: 10.1016/j.bpg.2006.05.004.
10. Banz V, Gsponer T, Candinas D, et al. Population-based analysis of 4113 patients with acute cholecystitis defining the optimal time-point for laparoscopic cholecystectomy. Ann Surg 2011;254(6):964–970. DOI: 10.1097/SLA.0b013e318228d31c.
11. Russo MW, Wei JT, Thiny MT, et al. Digestive and liver diseases statistics, 2004. Gastroenterology 2004;126(5):1448–1453. DOI: 10.1053/j.gastro.2004.01.025.
12. Papi C, Catarci M, D'ambrosio L, et al. Timing of cholecystectomy for acute calculous cholecystitis: a meta-analysis. Am J Gastroenterol 2004;99(1):147. DOI: 10.1046/j.1572-0241.2003.04002.x.
13. Ambe P, Weber SA, Christ H, et al. Cholecystectomy for acute cholecystitis. How time-critical are the so called "golden 72 hours"? Or better "golden 24 hours" and "silver 25–72 hour"? A case control study. World J Emerg Surg 2014;9(1):60. DOI: 10.1186/1749-7922-9-60.
14. Kerwat D, Zargaran A, Bharamgoudar R, et al. Early laparoscopic cholecystectomy is more cost-effective than delayed laparoscopic cholecystectomy in the treatment of acute cholecystitis. Clinicoecon Outcomes Res 2018;10:119–125. DOI: 10.2147/CEOR.S149924.
15. Menahem B, Mulliri A, Fohlen A, et al. Delayed laparoscopic cholecystectomy increases the total hospital stay compared to an early laparoscopic cholecystectomy after acute cholecystitis: an

updated meta-analysis of randomized controlled trials. HPB (Oxford) 2015;17(10):857–862. DOI: 10.1111/hpb.12449.
16. Kolla SB, Aggarwal S, Kumar A, et al. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a prospective randomized trial. Surg Endosc 2004;18(9):1323–1327. DOI: 10.1007/s00464-003-9230-6.
17. Gul R, Dar RA, Sheikh RA, et al. Comparison of early and delayed laparoscopic cholecystectomy for acute cholecystitis: experience from a single center. N Am J Med Sci 2013;5(7):414–418. DOI: 10.4103/1947-2714.115783.
18. Sánchez-Carrasco M, Rodríguez-Sanjuán JC, Martín-Acebes F, et al. Evaluation of early cholecystectomy versus delayed cholecystectomy in the treatment of acute cholecystitis. HPB Surg 2016;2016:4614096. DOI: 10.1155/2016/4614096.
19. Skouras C, Jarral O, Deshpande R, et al. Is early laparoscopic cholecystectomy for acute cholecystitis preferable to delayed surgery? Best evidence topic (BET). Int J Surg 2012;10(5):250–258. DOI: 10.1016/j.ijsu.2012.04.012.
20. Gurusamy K, Samraj K, Gluud C, et al. Meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 2010;97(2):14–50. DOI: 10.1002/bjs.6870.
21. Gurusamy KS, Davidson C, Gluud C, et al. Early versus delayed laparoscopic cholecystectomy for people with acute cholecystitis. Cochrane Database Syst Rev 2013;30. DOI: 10.1002/14651858.CD005440.pub3.
22. Cao AM, Eslick GD, Cox MR. Early cholecystectomy is superior to delayed cholecystectomy for acute cholecystitis: a meta-analysis. J Gastrointest Surg 2015;19(5):848–857. DOI: 10.1007/s11605-015-2747-x.
23. Wu XD, Tian X, Liu MM, et al. Meta-analysis comparing early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 2015;102(11):1302–1313. DOI: 10.1002/bjs.9886.
24. Iwashita Y, Ohyama T, Honda G, et al. What are the appropriate indicators of surgical difficulty during laparoscopic cholecystectomy? Results from a Japan-Korea-Taiwan multinational survey. J Hepatobiliary Pancreat Sci 2016;23(9):533–547. DOI: 10.1002/jhbp.375.
25. Kohga A, Suzuki K, Okumura T, et al. Outcomes of early versus delayed laparoscopic cholecystectomy for acute cholecystitis performed at a single institution. Asian J Endosc Surg 2019;12(1):74–80. DOI: 10.1111/ases.12487.
26. Arafa AS, Khairy MM, Amin MF. Emergency versus delayed laparoscopic cholecystectomy for acute cholecystitis. Egypt J Surg 2019;38(2):171. DOI: 10.4103/ejs.ejs_5_19.
27. Abdelkader AM, Ali HE. Laparoscopic cholecystectomy for management of acute calculous cholecystitis within and after 3 days of symptom beginning: a retrospective study. Egypt J Surg 2018;37(1):46–52. DOI: 10.4103/ejs.ejs_91_17.
28. Song GM, Bian W, Zeng XT, et al. Laparoscopic cholecystectomy for acute cholecystitis: early or delayed? Evidence from a systematic review of discordant meta-analyses [published correction appears in Medicine (Baltimore) 2016;95(28):e0916]. Medicine (Baltimore) 2016;95(23):e3835. DOI: 10.1097/MD.0000000000003835.
29. Zhou MW, Gu XD, Xiang JB, et al. Comparison of clinical safety and outcomes of early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis. Scientific World J 2014;2014:274516. DOI: 10.1155/2014/274516.
30. Chhajed R, Dumbre R, Fernandes A, et al. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a comparative study. Int Surg J 2018;5(4):3381–3385. DOI: 10.18203/2349-2902.isj20184093.
31. Roulin D, Saadi A, Di Mare L, et al. Early versus delayed cholecystectomy for acute cholecystitis, are the 72 hours still the rule? A randomized trial. Ann Surg 2016;264(5):717–722. DOI: 10.1097/SLA.0000000000001886.
32. Ozkardeş AB, Tokaç M, Dumlu EG, et al. Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a prospective, randomized study. Int Surg 2014;99(1):56–61. DOI: 10.9738/INTSURG-D-13-00068.1.
33. Johner A, Raymakers A, Wiseman SM. Cost-utility of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Surg Endosc 2013;27(1):256–262. DOI: 10.1007/s00464-012-2430-1.
34. Wilson E, Gurusamy K, Gluud C, et al. Cost-utility and value-of-information analysis of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Br J Surg 2010;97(2):210–219. DOI: 10.1002/bjs.6872.
35. Agrawal R, Sood KC, Agarwal B. Evaluation of early versus delayed laparoscopic cholecystectomy in acute cholecystitis. Surg Res Pract 2015;2015:349801. DOI: 10.1155/2015/349801.