ORIGINAL ARTICLE

Early Laparoscopic Cholecystectomy Is the Preferred Management of Acute Cholecystitis

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Hypothesis: Early laparoscopic cholecystectomy (LC) results in a shorter length of stay and acceptable conversion and complication rates when compared with antibiotic therapy plus interval LC or percutaneous cholecystostomy in patients admitted to a surgical service because of acute cholecystitis. However, actual practice does not conform to current evidence.

Design: Retrospective cohort study.

Setting: Urban teaching hospital.

Methods: Data were abstracted from the medical records of all patients with acute cholecystitis admitted to the surgical service via the emergency department during 36 months (October 1, 2002, to September 30, 2005). Patients were divided into 5 groups on the basis of treatment received. Length of stay, duration of symptoms, major complications, and conversion rates were analyzed.

Results: Of 173 patients with acute cholecystitis, 71 (41%) underwent early LC. Of 102 patients treated with antibiotic therapy alone (59%), 57 were discharged; antibiotic therapy was unsuccessful in 45 patients. Of the patients in whom antibiotic therapy was unsuccessful, 26 underwent late LC and 19 underwent percutaneous cholecystostomy. Interval LC was eventually performed in 55 patients who did not undergo surgery during the index admission. Length of stay was significantly shorter in the early LC group compared with the interval LC group ($P < .001$). Conversion rates were not statistically different for the 3 LC groups (early LC, 5.6%; late LC, 11.5%; and interval LC, 9.1%). The only biliary complication occurred in the interval LC group.

Conclusions: Early laparoscopic cholecystectomy resulted in a significantly reduced length of stay, no major complications, and no significant difference in conversion rates when compared with initial antibiotic treatment and interval LC. Despite these advantages, early LC is not the most common treatment for acute cholecystitis in practice.

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GENERAL SURGEONS IN THE United States perform approximately 700 000 laparoscopic cholecystectomies (LCs) annually.[1] Beginning in the early 1990s, authors began to describe techniques and indications for laparoscopic management of the acutely inflamed gallbladder.[2] During the last several years, various studies have addressed the optimal timing of LC in patients with acute cholecystitis.[3-9] A Japanese meta-analysis of 10 prospective, randomized trials of open cholecystectomy and LC from around the world concluded that early cholecystectomy, within 24 to 96 hours, during the index admission results in shorter hospital length of stay (LOS) and has similar complication and conversion rates compared with interval operations performed several weeks after the index admission.[10] In addition, at least 1 group has shown that delaying LC results in increased morbidity and may lead to unnecessary readmission of patients awaiting surgery.[11]

Despite this accumulation of evidence, it remains common practice to treat acute cholecystitis with intravenous (IV) antibiotic therapy and interval LC preferentially. This study was undertaken to evaluate whether early LC was being performed at our institution and to serve as a pilot study for a much larger database analysis that may guide our future practice. We hypothesized that, while early LC results in shorter LOS and acceptable rates of conversion and complications when compared with delayed surgery, this is not the dominant treatment strategy at our institution.

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METHODS

All patients with acute cholecystitis admitted to the surgical service of Kaiser Permanente Los

Table 1. Characteristics of 173 Patients at Admission

Characteristic	Early LC (n=71)	Late LC (n=26)	Interval LC (n=55)	Antibiotic Therapy (n=11)	Antibiotic Therapy Plus PC (n=10)
Age, mean (SD), y	41.2 (14.2)	44.1 (13.8)	48.4 (16.3)	55.8 (15.2)	72.6 (8.7)
Sex, No.					
Male	18	8	15	4	5
Female	53	18	40	7	5
Duration of symptoms, mean (range), d	1.4 (0.5-5)	2.4 (0.5-7)	2.3 (0.3-7)	4.5 (1-10)	2.4 (4-11)
WBC count, cells	13.4	15.0	12.2	12.8	14.2
US score, scale of 0 to 5	2.1	1.9	2.2	2.0	2.0

Abbreviations: LC, laparoscopic cholecystectomy; PC, percutaneous cholecystostomy; US, ultrasonography; WBC, white blood cell.
SI conversion factor: To convert WBCs to cells per microliter, divide by 0.001.

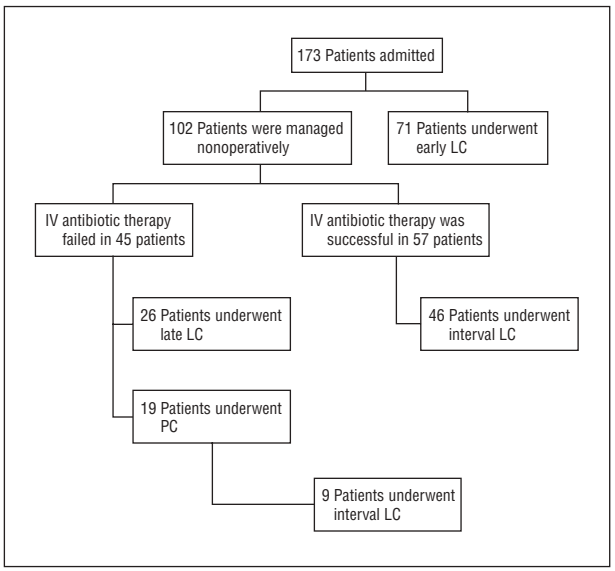

Figure. Treatment in 5 groups of patients with acute cholecystitis. IV indicates intravenous; LC, laparoscopic cholecystectomy; and PC, percutaneous cholecystostomy.

Angeles Medical Center, an urban teaching hospital, during the 36 months from October 1, 2002, to September 30, 2005, were identified via a computerized search of *International Classification of Diseases, Ninth Revision* and *Current Procedural Terminology, Fourth Edition* diagnosis and procedure codes. The study was conducted with the approval of the institutional review board. The diagnosis of acute cholecystitis was made on the basis of a combination of findings at clinical examination (right upper quadrant tenderness and Murphy sign), laboratory data (leukocytosis, white blood cell count $>11 \times 10^9$/L [to convert to $\times 10^9$ per liter, multiply by 0.001]), and sonographic evidence of gallstones, thickened gallbladder wall, pericholecystic fluid, and/or sonographic Murphy sign. Hepatobiliary iminodiacetic acid-enhanced scintigraphy was performed only in equivocal cases to demonstrate obstruction of the cystic duct. Patients with isolated gallstone pancreatitis and choledocholithiasis were excluded. Initial evaluation in the emergency department was conducted by a resident (postgraduate year 4 or 5) supervised by an attending surgeon. Operative decisions were made at the discretion of the attending surgeon. Some patients were referred to subsequent on-call teams to facilitate early operation. Patients were divided into the following 5 groups on the basis of treatment received: (1) Early LC, within 24 hours of admission; (2) late LC, after medical management with IV antibiotic therapy failed during the index admission, indicated by persistent right upper quadrant tenderness and leukocytosis; (3) interval LC, 2 weeks to 2 years after the index admission in patients who responded to IV antibiotic therapy alone or in combination with decompression via percutaneous cholecystostomy (PC); (4) intravenous antibiotic therapy alone as definitive therapy during the index admission; and (5) percutaneous cholecystostomy as definitive therapy during the index admission.

A course of broad-spectrum IV antibiotic therapy was administered to all patients. Laparoscopic cholecystectomy was performed by surgical residents (postgraduate years 2-5) under the supervision of experienced attending surgeons using the critical-view-of-safety technique described by Strasberg et al.[12] Intraoperative cholangiography was highly selective. Percutaneous cholecystostomy was reserved for patients whose condition worsened with IV antibiotic therapy and who did not undergo early LC because of some combination of resource constraints, surgeon discretion, persistent symptoms lasting longer than 4 days, or relative contraindications to general anesthesia. Percutaneous cholecystostomy was performed by the interventional radiology service.

Medical records were abstracted for demographic data; duration of symptoms at initial presentation, white blood cell count, and ultrasonographic findings at admission; operative findings; reason for and rate of conversion to open cholecystectomy; major complications; and LOS. Ultrasonographic findings were analyzed for the presence of gallbladder wall thickening, pericholecystic fluid, Murphy sign at ultrasonography, gallstones, and dilation of the common bile duct. One point was given per category, and an ultrasonographic score was achieved by addition of positive categories for a maximum of 5 points. Because interval LC was performed in the outpatient setting, we omitted the partial day of care in the ambulatory surgery center for calculation of LOS except where conversion or complication required hospital admission. Continuous variables were compared between early and interval LC and between early and late LC using independent sample *t* tests. Categorical variables were compared using χ^2 and pairwise Fisher exact tests. In all analyses, $P<.05$ was considered significant.

RESULTS

The demographic characteristics of the entire cohort of 173 patients admitted because of acute cholecystitis are given in **Table 1**. Treatment in the 5 patient groups is illustrated in the **Figure**. A minority of patients (n=71 [41%]) underwent early LC. Most patients (n=102 [59%]) were initially managed nonoperatively with IV antibiotic therapy. Patients who failed to improve with anti-

biotic therapy alone (45 of 102 [44%]) underwent either late LC (26 of 45 [58%]) or PC (19 of 45 [42%]).

Indications for PC included relative contraindication to general anesthesia in 1 patient, persistent symptoms lasting beyond 4 days in 5 patients, and a combination of resource constraints and surgeon discretion in 13 patients. Of the 19 patients who underwent PC, 9 eventually underwent interval LC and 10 received no further therapy. There was no statistically significant difference in LOS or duration of symptoms between the groups (**Table 2**); however, patients in the PC (no surgery) group were 2 decades older ($P=.003$).

Treatment with antibiotic therapy alone was successful in 57 of 102 patients (56%); most patients in this group (46 of 57 [81%]) later underwent interval LC as outpatients. There was no statistically significant difference in white blood cell count, duration of symptoms, or ultrasound score at admission for patients in whom antibiotic therapy was successful compared with those in whom antibiotic therapy failed (**Table 3**).

Eleven patients received medical therapy alone and no further intervention. Of these patients, 1 died of metastatic carcinoma from another source, 1 patient was lost to follow-up, 3 had multiple medical problems and were judged high-risk surgical candidates, and the remaining 6 refused surgery.

Length of stay and duration of symptoms were significantly longer in the interval LC and late LC groups compared with the early LC group ($P<.001$ and $P<.002$, respectively; **Table 4**). There was no statistical difference in conversion rates among the 3 surgical groups; the overall conversion rate was 7.9%. The most common reason for conversion was obscured anatomy secondary to dense adhesions, thickening, and fibrosis. One patient in the early LC group underwent intraoperative cholangiography, which did not show evidence of negative for choledocholithiasis.

In the late LC group, there was 1 minor bile duct injury, resulting in cystic duct stump leak and biloma that was treated by percutaneous drainage and endoscopic retrograde cholangiography with stenting. There were no major bile duct injuries, no cardiac or pulmonary events, and no deaths.

Overall, 41% of patients with acute cholecystitis underwent early LC, 15% underwent late LC, 32% underwent interval LC, and 12% received no further treatment. Thus, 88% of patients ultimately underwent surgery.

Table 2. Treatment in the Percutaneous Cholecystostomy Group

Variable	Treatment: Interval LC (n=9)	Treatment: No Surgery (n=10)	*P* Value
Age, mean (SD), y	50.8 (18.2)	72.6 (8.7)	.003
Duration of symptoms, mean (range), d	2.7 (1-7)	2.4 (1-4)	.74
Length of stay, mean (range), d	6.6 (4-11)	5.9 (4-11)	.65

Abbreviation: LC, laparoscopic cholecystectomy.

Table 3. Comparison of Late LC and Interval LC Groups

Variable	Late LC (n=26)	Interval LC (n=55)	*P* Value
Age, mean (SD), y	44.1 (13.8)	48.4 (16.3)	>.99
Duration of symptoms, d	2.4 (0.5-7)	2.3 (0.3-7)	.25
WBC count at admission, cells $\times 10^9$/L	15.0	12.2	.32
US score, scale of 0 to 5	1.9	2.2	.16

Abbreviations: LC, laparoscopic cholecystectomy; WBC, white blood cell; US, ultrasonography.

SI conversion factor: To convert WBCs to cells per microliter, divide by 0.001.

COMMENT

The indication for approximately 20% of present-day cholecystectomies is acute cholecystitis.[13] As long as 4 decades ago, surgeons began to recognize that early cholecystectomy is the preferred strategy for managing the acutely inflamed gallbladder because the edematous plane facilitates dissection and single-stage definitive treatment lessens both the total duration of morbidity and the potential for late complications such as gangrenous or emphysematous cholecystitis.[14] The evidence of benefit from early operation became persuasive via prospective randomized trials in the 1980s.[15,16] As LC became dominant in the early 1990s, some early adopters began to accept the challenge of a laparoscopic approach to acute cholecystitis.[2] Conversion rates were high. As techniques and equipment have improved, conversion and complication rates have declined compared with those initial reports.[15,17,18] Our recent experience of an overall conversion rate of 7.9% and no major bile duct injuries in 152 patients operated on because of acute cholecystitis reflects that trend. We believe that our adoption of the critical-view-of-safety technique is responsible in large part for the low conversion rates and lack of major bile duct injuries. We have not found cholangiography to be of much value in acute cholecystitis because the critical view provides all necessary anatomic information and severe inflammation frequently makes it hazardous or impossible to cannulate the cystic duct.

In our experience, early LC, compared with any other treatment strategy, results in significantly reduced LOS. Reduced LOS is likely associated with reduced overall cost for those patients who will ultimately require surgery. Completion of treatment during the index admission is likely to result in fewer total days of recovery. These are compelling arguments with considerable support in the literature, yet they have not succeeded in changing surgical practice. Reasons for slow adoption of early LC at our institution and others may include lack of acceptance of current evidence; a persistent, if misguided, belief in the idea of "cooling off" a "hot" gallbladder; patient factors such as delayed presentation or comorbidities; surgeon convenience; or resource constraints such as surgeon availability or timely access to operating rooms.

Table 4. Comparison of LOS and Conversion Rates for Early, Late, and Interval LC Groups

Variable	Early LC (n=71)	Late LC (n=26)	Interval LC (n=55)	*P* Value: Early LC vs Interval LC	*P* Value: Early LC vs Late LC
Duration of symptoms, mean (range), d	1.4 (0.5-5)	2.4 (0.5-7)	2.3 (0.3-7)	.002	.002
LOS, mean (range), d	2.0 (1-7)	5.4 (3-10)	4.9 (2-11)	.001	.001
Conversion to open cholecystectomy, No. (%)	4 (5.6)	3 (11.5)	5 (9.1)	.50	.39

Abbreviations: LC, laparoscopic cholecystectomy; LOS, length of stay.

ACCEPTANCE OF CURRENT EVIDENCE

A recent survey of Japanese surgeons showed that the percentage adopting a policy of early LC as of 2006 (42%) was similar to the percentage of patients in our study who underwent early LC.[10] A survey of surgeons in the United Kingdom published in 2004 showed that just 20% of respondents claimed to perform routine early LC in patients with acute cholecystitis. The British authors concluded that the low rate of adoption of early LC reflected a lack of experienced surgeons and difficult access to operating rooms.[19]

PATIENT FACTORS

Compared with our early LC group, patients who underwent PC were considerably older (approximately 3 decades) but did not have substantially longer duration of symptoms; patients who underwent early LC and interval LC were similar in age. This suggests a reluctance to operate on older patients with acute cholecystitis. Some authors have argued that the conventional wisdom about taking a gradual approach to the aging patient with acute cholecystitis is wrong.[20] Despite the attendant morbidity and mortality with complicated acute cholecystitis, outcomes were improved by early open cholecystectomy in a British population during the 1980s.[21] We did not attempt to quantitate comorbidities in our series, nor did we analyze men and women separately, though this will be done in a subsequent and much larger regional database analysis.

SURGEON CONVENIENCE

Any examination of the timing of LC must at least consider the effect on surgeons of the unpredictable arrival of patients whose condition is perceived as something less than an emergency. While this factor may not be quantifiable, there can be little doubt that it affects the rate of early LC in some settings. Convenience may also be a factor that drives the increased use of PC, inasmuch as only 1 of 19 patients had unequivocal contraindications to early operation.

RESOURCE ALLOCATION

Thin staffing of operating rooms has become an economic necessity, yet it has the potential for unintended consequences. Hospital managers may not appreciate the true economic implications of an operating room bottleneck that, in turn, may increase inpatient bed utilization by patients waiting for surgery. In addition, surgeons may be engaged in competing professional activities that limit their availability to operate when indicated. We are currently developing an economic analysis that will help to illustrate these phenomena.

STUDY LIMITATIONS

Our study has the usual limitations of a retrospective review. There is likely some degree of selection bias. The number of patients is relatively small, introducing a risk of type II error. Because treatment choices were made in the real world at surgeon discretion, there were no consistent criteria for assignment of patients to specific courses. Omission of any added LOS for outpatient interval LC and omission of time in the hospital in calculation of duration of symptoms tend to bias the analysis in favor of interval LC. Thus, we believe that our conclusions are relatively conservative.

We conclude that early LC for patients with acute cholecystitis results in a substantially reduced LOS, no major complications, and no important difference in conversion rate when compared with initial antibiotic therapy and interval LC. The benefit to both patients and the health care system is apparent, yet actual practice does not conform to current evidence. For reasons known since the 1960s and now firmly established as valid, efficient, effective, and safe in the laparoscopic era, we renew the plea to our colleagues worldwide to adopt a consistent policy of early LC unless specifically contraindicated.

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