RESEARCH PAPER

# Early versus Delayed Laparoscopic Cholecystectomy in Acute Cholecystitis: A Narrative Review

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*ABSTRACT*

Cholecystitis, an acute inflammation of the gallbladder, is one of the most important surgical diseases. In most cases, the cystic duct becomes obstructed by a gallstone, causing the inflammation, and laparoscopic cholecystectomy is the gold standard for treatment. However, the timing of surgery is still up for debate; the traditional approach is to delay laparoscopic cholecystectomy until after conservative medical management has been completed because of concerns about inflammation and operating on a previously inflamed organ with a lot of scar tissue forming around it. However, the trend is toward early laparoscopic cholecystectomy, typically performed within 72 hours after the onset of acute cholecystitis or during the initial hospitalization. The purpose of this article is to summarize the evidence from the literature comparing early vs. delayed laparoscopic cholecystectomy in patients with acute cholecystitis, with a focus on clinical outcomes, safety, and cost-effectiveness. To evaluate the evidence, we conducted a systematic review of the published literature, including randomised controlled trials, observational studies and meta-analyses, to determine what the outcomes of the patients were related to operative difficulty, complication rates, conversion to open cholecystectomy, length of stay in the hospital, recurrence of biliary events, and total costs of providing healthcare for the patient. The literature demonstrates a consistent advantage to an early laparoscopic cholecystectomy; safety and efficacy, shorter hospital stays, lower cost, less risk of recurrent complications, and comparable or lower complication and conversion rates. In addition to the benefits, the use of delayed laparoscopic cholecystectomy may still be appropriate for some high-risk patients and for hospitals with limited capacity to operate on inflamed gallbladders; however, delayed laparoscopic cholecystectomy is associated with a higher rate of recurrent symptoms and hospitalizations. Early Laparoscopic Cholecystectomy is the procedure of choice for the average patient with acute cholecystitis and should be pursued whenever possible, considering the patient's particular clinical situation and the available resources of the hospital.

**KEYWORD:** Acute Cholecystitis, Cholecystectomy, Laparoscopic, Early Surgical Intervention, Delayed Surgery, Treatment Outcome.

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## INTRODUCTION

Acute cholecystitis is a common cause of acute abdominal pain necessitating surgical intervention across the globe. It is most often associated with gallstones that become trapped in the cystic duct, causing the gallbladder to become inflamed, swollen, and, in more severe cases, infected and necrotic (1). With the increase of gallstones due to changes in how people eat and live, acute cholecystitis continues to rise, placing a heavy burden on healthcare systems (2).

Laparoscopic cholecystectomy has become the treatment of choice for treating acute cholecystitis rather than open surgical procedures because of the many advantages of laparoscopic cholecystectomy, including fewer complications, less postoperative pain, shorter hospital stays, faster recovery, and improved cosmetic appearance. Despite its broad acceptance, controversy persists over the optimal timing for performing the procedure, with ongoing discussions among surgeons, physicians, and other healthcare providers (1,3).

Historically, the conventional treatment involved performing the operation after a period of conservative management using antibiotics, and then undergoing

the actual surgical procedure a few weeks after the initiation of treatment. It was thought that allowing the patient to recover from the acute inflammatory process would reduce the risk of complications and improve the likelihood of completing the surgical procedure with relative ease. However, this conventional approach to treatment is fraught with several disadvantages, including increased frequency of hospital admissions for recurrent biliary events, increased cost to the patient and the system for the management of these recurrent biliary events, and discomfort to the patient associated with waiting for treatment (4,5).

On the other hand, there has been increasing support in recent years for early laparoscopic cholecystectomy performed within 72 hours of the development of symptoms or admission (at least after presenting with symptoms of acute cholecystitis). Improvements in surgical techniques, as well as evolving perioperative care protocols and greater experience with performing laparoscopic procedures, have all aided in increasing the overall efficiency and safety of performing surgery during this time frame (6,7).

However, the controversy concerning the timing of procedure performance remains, especially concerning individuals who present later in the course of their illness, elderly individuals, and those patients with significant comorbidities. Additionally, the timing of surgery still relies heavily on institutional resources, surgeon practice style/experience, and patient selection criteria.

Thus, there is a critical and urgent need to conduct an overall synthesis of the current evidence to better understand the relative risks, benefits, and limitations of performing early laparoscopic cholecystectomy compared to delayed laparoscopic cholecystectomy for the management of acute cholecystitis. This narrative review aims to evaluate and synthesise the current existing literature regarding the timing of laparoscopic cholecystectomy in the management of acute cholecystitis and provide an objective understanding of the clinical outcomes, safety, and economic impacts of both early and delayed laparoscopic cholecystectomy, thereby providing a clear and evidence-based perspective for clinical practice, based upon the findings of this overall review.

## METHODOLOGY

The purpose of this review was to synthesize the existing literature related to the timing (when) of laparoscopic cholecystectomy in acute cholecystitis (what). A broad search was conducted using available sources in key electronic databases (where) such as PubMed, Scopus, and the Cochrane Library. Researchers used a number of keywords for their searches (i.e., “acute cholecystitis,” “laparoscopic cholecystectomy,” “early cholecystectomy,” “delayed cholecystectomy,” timing of surgery). Boolean operators were used in order to develop a more focused search strategy and improve the chance of retrieving all applicable literature.

Relevant studies were identified using a combination of keywords such as “acute cholecystitis,” “laparoscopic cholecystectomy,” “early cholecystectomy,” “delayed cholecystectomy,” and “timing of surgery.” Boolean operators were applied to refine the search strategy and ensure comprehensive retrieval of relevant literature.

Only randomized controlled trials, systematic reviews, meta-analyses, and cohort studies evaluating the clinical outcome between early and delayed laparoscopic cholecystectomy were included. More emphasis was placed on using articles published in the past 20 years (the last two decades) in order to include what has been done in the area of surgery recently, however landmark studies were utilized where applicable.

The inclusion criteria for this review included studies that examined adult patients with acute calculus cholecystitis. Studies that were not in English were excluded. Case reports and studies without specific, clear outcome measures were excluded from this review.

For each selected study, the data were qualitatively analyzed and synthesized, with particular attention paid to operative outcomes, complication rates, rate of conversion to open surgery, length of hospitalization, recurrence of biliary events, and cost-effectiveness of surgery. The authors of this review phenomenologically synthesized the data in order to provide a predominant view of current information with regard to both the advantages of and the limitations of performing surgery early and/or delaying surgery.

## PATHOPHYSIOLOGY AND RATIONALE FOR TIMING

The most common reason for why a person has been diagnosed with acute cholecystitis is because the cystic duct has been blocked off, usually by gallstones. The cystic duct blockage results in an increase in distended gallbladder size, and this then triggers an inflammatory response. Once this initial phase starts, the following occurs by increasing the amount of intraluminal pressure, thus resulting in impaired drainage from both the venous and lymphatic systems and mucosal ischemia; once this has occurred, inflammatory mediators will be released causing edema, wall thickening and infiltration of inflammatory cells (8,9).

Once a person progresses to the stage of having an acute cholecystitis, their timing for surgical intervention becomes increasingly important. In the early phase of their symptoms, usually within the first 72 hours, the major inflammatory changes are due to increased edema and hyperemia. Therefore, at this point in time, tissue planes have lost little integrity and dissection should therefore be easier because of the presence of large amount of edema. In most cases, early laparoscopic cholecystectomy procedures can be done safely and may even lead to more favorable conditions when performing the procedure (10,11).

As the disease progresses later than just having the acute cholecystitis phase, the ongoing inflammation eventually leads to fibrosis, adhesion formation, and distortion of normal anatomy. Consequently, all these changes can obscure Calot's triangle and therefore, will make dissection much more difficult, leading to an increased risk of intraoperative complications, such as injury to the bile duct and conversion from laparoscopic to open surgery. This provides the theoretical basis of having a delayed laparoscopic cholecystectomy done after initially being managed conservatively, to allow for inflammation to subside prior to surgery (12,13).

Although the previous rationale or theory provided a strong basis for delaying surgical intervention, doing so creates its own set of challenges. Patients who were conservatively managed who have returned to the hospital for subsequent biliary events will need additional surgical intervention for recurrent episodes of cholecystitis, biliary colic, pancreatitis, or cholangitis, and will likely require an urgent readmission, necessitating more urgent surgical intervention. In addition, patients who experience repeated episodes of inflammation will have additional complications from the above surgical procedure, to include increased rates of fibrosis and adhesion formation (14).

The laparoscopic surgical technique, better imaging techniques, improved perioperative care and the increased experience of surgeons operating in the acute inflammatory phase have changed the management paradigm for these patients. Laparoscopic cholecystectomy could now be safely performed in the acute inflammatory phase; thusly, this has called into question the traditional preference for having a delayed cholecystectomy (15).

So, the timing for performing a laparoscopic cholecystectomy is based on striking a balance between operating in the early inflammatory phase, which may have more favorable conditions and avoiding the risks of having to perform a delayed procedure. The ability to understand the pathophysiologic changes associated with this condition is necessary for assisting with how decisions are made and also for the interpretation of published literature (16). The decision making in regards to the timing for performing a laparoscopic cholecystectomy has been summarized in **Figure 1** considering the established pathophysiologic changes and clinical considerations.

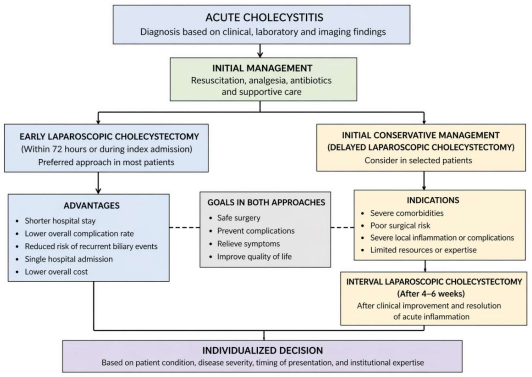


**Figure 1: Clinical decision-making pathway for early versus delayed laparoscopic cholecystectomy in acute cholecystitis**

## EVIDENCE ON TIMING OF LAPAROSCOPIC CHOLECYSTECTOMY

A wide variety of research has investigated the ideal time to perform laparoscopic cholecystectomy for patients with acute cholecystitis. The literature includes randomized trials, large observational studies, and many meta-analyses. The accumulating

evidence continues to show that early surgical management is preferred, though some differences exist depending on patient population and clinical scenario (17,18).

Randomized trials consistently demonstrate the safety and effectiveness of early laparoscopic cholecystectomy. Early randomized trials comparing the timing of cholecystectomy from 24-72 hours post-admission versus deferred surgery showed a significant decrease in overall length of hospital stay without increasing perioperative morbidity or mortality. These studies also demonstrate that early surgery avoids the need for a second hospitalization for patients, which improves their comfort and increases the utilization of healthcare services (6,16,19).

Numerous observational studies and large retrospective studies have also supported these findings in a variety of patient populations. Large cohort analyses demonstrate a lower complication rate overall with early laparoscopic cholecystectomy as compared to delayed laparoscopic cholecystectomy, a lower risk of injury to the bile duct, and a decreased need to convert to open surgery. In addition, performing surgery at an early stage minimizes the chance of experiencing recurrent biliary events that tend to occur during the waiting period that results from delayed management strategies. This supports the feasibility of performing early surgery outside a controlled-trial environment (6,20).

Meta-analyses and systematic reviews represent the most comprehensive available literature on the subject. Both prior research and clinical practice have confirmed that early laparoscopic cholecystectomy is safe, and has favorable outcomes in terms of cost, hospital stay, and complication rates compared to later surgeries. In addition, the evidence is clear that early laparoscopic cholecystectomy can be performed by experienced surgeons without any statistically significant change in procedure time and difficulty (21).

The traditional idea behind delaying laparoscopic cholecystectomy until several weeks of conservative management have passed before the case is scheduled to proceed revolves around the belief that as inflammation resolves, the procedure becomes safer. While there are still occasions to appropriately delay laparoscopic cholecystectomy to optimally manage patients—namely, in high-risk patients or when immediate surgical expertise is not available—an accumulation of studies have shown the disadvantages of delaying surgery, including recurrent symptoms, multiple hospitalizations, and progression of disease (22,23).

Recent studies have begun to explore the feasibility of extending the “early” timeframe for laparoscopic cholecystectomy beyond 72 hours after symptom onset. There is a growing body of literature demonstrating that laparoscopic cholecystectomy can still be successfully performed for appropriate patients after 72 hours and even as far out as 1 week after symptom onset, assuming that there is adequate surgical expertise and institutional support. This study's findings challenge the traditional definition of “early” surgery to be patient-centered with appropriate planning specific to the patient and severity of the disease (16,24).

Also, studies evaluating patients receiving percutaneous gallbladder drainage as an intervention also support the evidence that a defined timeframe exists in which interval laparoscopic cholecystectomy can be performed safely after stabilization. The studies further support that the treatment plan for cholecystitis is individualized based on the patient's current status and related to the severity of disease (25).

The current body of evidence strongly supports early laparoscopic cholecystectomy as being the first-line treatment approach for acute cholecystitis in most patients. However, effective clinical judgment is critical, and the timing of treatment must be based on patient-specific characteristics, disease severity, and the availability of adequate resources.

## CLINICAL OUTCOMES AND COMPARATIVE ANALYSIS

There have been many studies comparing early and delayed laparoscopic cholecystectomy for treatment of acute cholecystitis. Studies have looked at many different factors including difficulty of surgery, complication rates, conversion to open surgery, length of stay, recurrences of biliary events, and overall cost. Most of these studies show a consistent trend favoring early intervention for most of these parameters (6,25).

Most studies show that operative time is similar for both early and delayed laparoscopic cholecystectomy. Early surgery may be perceived to be technically difficult due to inflammation, however, edema can help with dissection as the tissue planes can be

preserved. Likewise, delayed surgery may have increased difficulty due to the presence of fibrosis and dense adhesions (7,26).

Conversion to open surgery is an important indicator of surgical difficulty and safety. Recent evidence suggests that patients undergoing early cholecystectomy have similar, or lower, conversion rates than those who undergo delayed surgery. The differences in conversion rates are largely attributed to the absence of chronic inflammatory changes as well as anatomical distortion in delayed cases compared to those who have early surgery (7,13).

In terms of complication rates, patients undergoing early laparoscopic cholecystectomy have similar, or lower rates of complications following surgery, including bile duct injury, wound infection, and intra-abdominal collections. Furthermore, delaying surgery does not eliminate the possibility of complications and may actually increase the number of complications due to recurrent inflammation or progression of disease at the time of surgery.

Length of hospital stay is one of the most significant outcomes improved through use of early intervention; therefore, patients undergoing early laparoscopic cholecystectomy will typically remain in the hospital for a shorter period of time since they do not require an initial conservative management or readmission following a delay in surgery. This results not only in improved patient satisfaction, but also improves the utilization of the healthcare system's resources (27,28).

Having recurrent biliary events is a disadvantage of delaying laparoscopic cholecystectomy. Patients who are managed conservatively are often at risk of developing recurrent episodes of cholecystitis, biliary colic, pancreatitis, and cholangitis, which can lead to further complications and/or the need for emergency readmission prior to surgery (29).

Economically, patients undergoing early laparoscopic cholecystectomy will typically have lower overall costs of healthcare as all three components of cost-effective measurement (length of stay, number of readmissions, and complication rates) will be improved when patients undergo early laparoscopic cholecystectomy. In contrast, patients undergoing delayed laparoscopic cholecystectomy typically have higher cumulative costs as a result of repeated visits to the hospital and prolonged treatment (30).

The comparative clinical outcomes summarized in **Table 1** support the conclusion that early laparoscopic cholecystectomy provides a more cost-effective and efficient treatment modality for most patients with acute cholecystitis.

**TABLE 1 - Comparison of Early vs Delayed Laparoscopic Cholecystectomy**

| **Parameter** | **Early Laparoscopic Cholecystectomy** | **Delayed Laparoscopic Cholecystectomy** |
|---|---|---|
| Timing | Within 72 hours (or during index admission) | After 4–6 weeks of conservative management |
| Operative Difficulty | Moderate (edema aids dissection) | Variable (fibrosis and adhesions common) |
| Conversion to Open Surgery | Similar or lower | Similar or higher |
| Complication Rate | Comparable or lower | Comparable or slightly higher |
| Hospital Stay | Shorter (single admission) | Longer (multiple admissions) |
| Recurrence of Symptoms | Minimal | Higher risk during waiting period |
| Cost | Lower overall | Higher due to repeated admissions |

## SPECIAL SITUATIONS

Laparoscopic cholecystectomy is recommended for the majority of patients diagnosed with acute cholecystitis and is regarded as the optimal surgical method. However, as evidenced by the evidence provided above, individual patient circumstances will often dictate the timing of laparoscopic cholecystectomy (30).

For example, many patients who are deemed high risk (e.g., older patients with multiple comorbidities, such

as cardiovascular disease or diabetes, and patients who are functionally impaired) may not be able to tolerate immediate laparoscopic surgery and instead require initial conservative management, including antibiotic therapy and supportive care. For those patients who do not respond to this treatment and are impacted by the complications of their disease, percutaneous gallbladder drainage is often utilized as a temporizing measure. Once the patient is stable, it is safe for the patient to undergo an interval laparoscopic cholecystectomy, and the timing of this procedure should be planned to minimize the risk of complications and to minimize disease progression (31,32).

There is a specific subgroup of patients who have had percutaneous transhepatic gallbladder drainage (PTGBD). Clinical evidence suggests that laparoscopic cholecystectomy can be safely performed within a defined timeframe (typically after clinical stabilization and prior to the development of dense adhesion formation) (33,34). However, if the patient is not clinically stable, or if the timing of laparoscopic cholecystectomy is delayed beyond the optimal window, there is a risk that the technical challenges associated with dense adhesion formation and chronic inflammation will significantly negatively impact the success of the procedure.

Another unique issue that has recently been identified is the incidence of patients who present with acute cholecystitis beyond the conventional time frame of 72 hours. Historically, patients presenting with acute cholecystitis beyond the 72-hour timeframe were surgically managed with a delay because of fears that the technical challenges of performing laparoscopic cholecystectomy would be exacerbated due to the presence of chronic inflammatory changes associated with gallbladder obstruction. However, the development of a body of evidence demonstrating that laparoscopic cholecystectomy is safe for selected patients who present 72 hours or later after symptom onset (up to one week) has fostered consideration of a more flexible approach to surgical management rather than strict adherence to rigid criteria concerning timing of surgery (13,35).

In resource-constrained settings, many variables, including the availability of laparoscopic surgeons with expertise, operating facilities and perioperative support, will affect the timing of surgical intervention. As a result, while the associated benefits of early referral for laparoscopic cholecystectomy will still exist, many patients in resource-limited settings will continue to require delayed laparoscopic cholecystectomy for logistical reasons (36).

In summary, the examples presented herein emphasize the need for the individualization of surgical decision-making concerning the management of patients with acute cholecystitis. While laparoscopic cholecystectomy remains the treatment of choice for the majority of patients presenting with acute cholecystitis, patient factors, disease severity and institutional capabilities should be taken into consideration when determining the optimal time for surgery.

## DISCUSSION

Over the last several decades, the timing of laparoscopic cholecystectomy for patients with acute cholecystitis has changed dramatically. Traditionally, laparoscopic surgery has been delayed; however, in this regard, the timelines have shifted towards earlier intervention. In fact, the body of knowledge based on Randomized Trials, Observational Studies, and Meta-Analyses supports the belief that early laparoscopic surgery is a safe and effective treatment for the majority of patients (10,17).

A major advantage of early surgery is the inflammation characteristic of the acute phase of cholecystitis. In the first few days after the onset of symptoms, tissue edema and hyperemia can be beneficial to the dissection process because they provide good visibility of the anatomical planes. With time, the delayed surgery leads to increased amounts of fibrosis, adhesions, and distortion of the anatomical planes, which results in difficult operations and a potential increase in complications. Therefore, the pathophysiological basis for the prompt surgical intervention is well-supported (1,7,10).

Another important clinical benefit of early laparoscopic cholecystectomy is reduced total hospital length of stay, which lowers overall healthcare costs and decreases the number of recurrent biliary events. Moreover, eliminating multiple hospital visits improves patient satisfaction and reduces strain on the healthcare system. The aforementioned advantages apply particularly well to the high-volume center(s) and resource-limited settings, where there is a need for the efficient use of hospital resources (37,38).

Unfortunately, there are still certain circumstances in which a delay in laparoscopic cholecystectomy is

warranted. These circumstances often include those in which the patient has advanced age, multiple comorbidities, or an advanced presentation of the disease, as immediate surgical intervention may increase the risk for complications. Additionally, limitations in institutional resources, such as the limited availability of surgeons experienced in laparoscopic surgery and/or a lack of operating rooms, may necessitate a delay in surgery. In those circumstances, selecting and optimizing patients becomes critical to ensuring successful outcomes (6,39).

In addition, it must be noted that the definition of early laparoscopic cholecystectomy has changed over time. Historically, laparoscopic cholecystectomy was defined as performed within 72 hours of symptom onset; however, recent studies have shown that laparoscopic cholecystectomy remains a viable option beyond 72 hours and remains effective for patients up to the first week after symptom onset, provided adequate expertise is available. Therefore, it can be concluded that the rigid definitions regarding timing of surgical treatment have been challenged by the philosophy of patient-centered care (40).

Furthermore, considerable variability exists in the methods and populations included in the earlier studies. This variability affects the definition of early vs. delayed surgical intervention, expertise of the surgeon, and variability in the way outcomes are defined and reported. However, the consistency of the results from several well-performed studies adds to the validity of the conclusion that early intervention is warranted (41,42).

Current advancements in laparoscopic surgical techniques, perioperative care, and diagnostic imaging further enhance the safety and feasibility of early intervention. Moreover, these advancements have reduced the barriers that previously existed for choosing to delay surgical intervention (41,43).

Overall, the current literature provides strong evidence for a paradigm shift, with early laparoscopic cholecystectomy now the standard of care for acute cholecystitis. However, clinical judgment should always guide the decision-making process based on the individual patient's condition, disease severity, and available resources.

## CONCLUSION

When treating acute cholecystitis, also known as gallbladder inflammation caused by a blockage of the bile duct leading to accumulation of bile in the gallbladder, there are two main types of laparoscopic surgery that are used. The timing of laparoscopic cholecystectomy, the preferred type of surgery in patients with acute cholecystitis, can influence both patient outcomes and healthcare utilization. In addition to the impact on patient outcomes, the timing of laparoscopic cholecystectomy has a significant impact on healthcare utilization. There is now overwhelming evidence from multiple sources including randomized controlled trials, observational studies and meta-analyses that support performing early laparoscopic cholecystectomy as the preferred treatment for most patients.

Early laparoscopic cholecystectomy is usually performed within 72 hours after the initial presentation or during the index hospitalization, and it has been shown to result in shorter lengths of hospital stay, fewer complications overall, a lower risk of recurrent biliary events and improved cost-effectiveness compared to the delayed approach. The increase in surgical skills and perioperative care has further increased the safety and feasibility of performing early laparoscopic cholecystectomy.

The previous preferred option, delayed laparoscopic cholecystectomy, is now typically used in selected patients due to having greater comorbidities or the severity of their disease, or where there is limited access to immediate surgical services. In these situations, a targeted approach that considers each patient's unique characteristics and the resources at each institution will remain critical.

In conclusion, whenever feasible, early laparoscopic cholecystectomy should be considered the standard of care for managing patients with acute cholecystitis. Ongoing research should focus on developing optimal guidelines for patient selection and timing of surgery in more complex situations to improve patient outcomes.

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