

REVIEW

Current Management of Complicated Acute Cholecystitis: A Literature Review of Surgical and Minimally Invasive Strategies

Manejo actual de la colecistitis aguda complicada: revisión bibliográfica sobre estrategias quirúrgicas y mínimamente invasivas

Manejo atual da colecistite aguda complicada: revisão bibliográfica sobre estratégias cirúrgicas e minimamente invasivas

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ABSTRACT

Introduction: Complicated acute cholecystitis represents a spectrum of inflammatory and infectious disease of the gallbladder that includes gangrenous, emphysematous, perforated, empyematous, acalculous forms, as well as cases associated with abscesses, biliary peritonitis, or sepsis. Its management requires timely diagnosis, severity stratification, rational antibiotic therapy, and early source control. **Objective:** To synthesize the evidence published between 2021 and 2026 on the contemporary management of complicated acute cholecystitis, with emphasis on surgical and minimally invasive strategies. **Methods:** A narrative literature review was conducted using articles indexed in PubMed/MEDLINE, PMC, JAMA Network, EClinicalMedicine, SpringerLink, and ScienceDirect, prioritizing systematic reviews, meta-analyses, international consensus statements, recent clinical guidelines, and high-impact narrative review. **Results:** Early laparoscopic cholecystectomy during the index admission remains the treatment of choice in patients with sufficient physiological reserve. In cases of a difficult gallbladder, bailout strategies, particularly subtotal cholecystectomy, reduce the risk of bile duct injury when achieving the critical view of safety is not possible. In patients at high surgical risk, percutaneous cholecystostomy continues to play a relevant role as a bridge to definitive treatment or as selected definitive therapy; however, recent evidence favors cholecystectomy when the patient can tolerate it. Endoscopic ultrasound-guided gallbladder drainage is emerging as an effective alternative in centers with advanced expertise. **Conclusions:** Current management should be individualized through a multidisciplinary approach that integrates clinical severity, anesthetic risk, biliary anatomy, technological availability, and team expertise. The therapeutic priority is source control with the lowest possible morbidity.

Keywords: acute cholecystitis; complicated cholecystitis; laparoscopic cholecystectomy.

RESUMEN

Introducción: La colecistitis aguda complicada representa un espectro de enfermedad inflamatoria e infecciosa de la vesícula biliar que incluye formas gangrenosas, enfisematosas, perforadas, empiemáticas, acalculosas y asociadas a abscesos, peritonitis biliar o sepsis. Su manejo exige diagnóstico oportuno, estratificación de gravedad, antibioticoterapia racional y control precoz del foco. **Objetivo:** Sintetizar la evidencia publicada entre 2021 y 2026 sobre el manejo contemporáneo de la colecistitis aguda complicada, con énfasis en estrategias quirúrgicas y mínimamente invasivas. **Métodos:** Se realizó una revisión bibliográfica narrativa de artículos indexados en PubMed/MEDLINE, PMC, JAMA Network, EClinicalMedicine, SpringerLink y ScienceDirect, priorizando revisiones sistemáticas, metanálisis, consensos internacionales, guías clínicas recientes y revisiones narrativas de alto impacto. **Resultados:** La colecistectomía laparoscópica temprana durante el ingreso continúa siendo el tratamiento de elección en pacientes con reserva fisiológica suficiente. En escenarios de vesícula difícil, las estrategias de rescate, especialmente la colecistectomía subtotal, reducen el riesgo de lesión biliar cuando no es posible obtener una visión crítica de seguridad. En pacientes con alto riesgo quirúrgico, la colecistostomía percutánea mantiene un papel relevante como puente al tratamiento definitivo o como terapia definitiva seleccionada; no obstante, la evidencia reciente favorece la colecistectomía cuando el paciente puede tolerarla. El drenaje vesicular guiado por ecoendoscopia surge como alternativa efectiva en centros con experiencia avanzada. **Conclusiones:** El manejo actual debe individualizarse mediante un enfoque multidisciplinario que integre gravedad clínica, riesgo anestésico, anatomía biliar, disponibilidad tecnológica y experiencia del equipo. La prioridad terapéutica es el control del foco con la menor morbilidad posible.

Palabras clave: colecistitis aguda; colecistitis complicada; colecistectomía laparoscópica.

RESUMO

Introdução: A colecistite aguda complicada representa um espectro de doença inflamatória e infecciosa da vesícula biliar que inclui formas gangrenosas, enfisematosas, perfuradas, empiematosas, acalculosas e associadas a abscessos, peritonite biliar ou sepsis. Seu manejo exige diagnóstico oportuno, estratificação da gravidade, antibioticoterapia racional e controle precoce do foco infeccioso. **Objetivo:** Sintetizar as evidências publicadas entre 2021 e 2026 sobre o manejo contemporâneo da colecistite aguda complicada, com ênfase em estratégias cirúrgicas e minimamente invasivas. **Métodos:** Foi realizada uma revisão bibliográfica narrativa de artigos indexados nas bases PubMed/MEDLINE, PMC, JAMA Network, EClinicalMedicine, SpringerLink e ScienceDirect, priorizando revisões sistemáticas, metanálises, consensos internacionais, diretrizes clínicas recentes e revisões narrativas de alto impacto. **Resultados:** A colecistectomia laparoscópica precoce durante a internação continua sendo o tratamento de escolha em pacientes com reserva fisiológica suficiente. Em cenários de vesícula difícil, as estratégias de resgate, especialmente a colecistectomia subtotal, reduzem o risco de lesão biliar quando não é possível obter a visão crítica de segurança. Em pacientes com alto risco cirúrgico, a colecistostomia percutânea mantém papel relevante como ponte para o tratamento definitivo ou como terapia definitiva em casos selecionados; no entanto, evidências recentes favorecem a colecistectomia quando o paciente pode tolerá-la. A drenagem vesicular guiada por ecoendoscopia surge como alternativa eficaz em centros com experiência avançada. **Conclusões:** O manejo atual deve ser individualizado por meio de uma abordagem multidisciplinar que integre gravidade clínica, risco anestésico, anatomia biliar, disponibilidade tecnológica e experiência da equipe. A prioridade terapêutica é o controle do foco infeccioso com a menor morbidade possível.

Palavras-chave: colecistite aguda; colecistite complicada; colecistectomia laparoscópica.

INTRODUCTION

Acute cholecystitis is one of the most frequent abdominal surgical emergencies and, in most cases, is related to obstruction of the cystic duct by gallstones. Persistent inflammation, ischemia of the gallbladder wall, bacterial superinfection, and the host systemic response can lead to complicated forms, with increased morbidity, hospital stay, and need for urgent interventions.⁽¹⁻³⁾

The term complicated acute cholecystitis should not be limited to gallbladder perforation. In clinical practice, it comprises a heterogeneous set of scenarios, including gangrenous cholecystitis, emphysematous cholecystitis, gallbladder empyema, perivesicular or hepatic abscess, biliary peritonitis, acalculous cholecystitis in critically ill patients, biliary-source sepsis, cholecystoenteric fistulas, and a gallbladder with difficult dissection due to intense inflammation. This heterogeneity

makes it necessary to avoid rigid algorithms and to prioritize decisions based on clinical severity, source control, and anatomical safety.^(2,3)

In recent years, the therapeutic strategy has evolved from a dichotomy between early surgery and percutaneous drainage toward a stepwise and multidisciplinary model. Early laparoscopic cholecystectomy remains the standard in operable patients; however, bailout techniques, subtotal cholecystectomy, intraoperative cholangiography, indocyanine green fluorescence, percutaneous cholecystostomy, and endoscopic gallbladder drainage have expanded the options available for patients with difficult anatomy or high surgical risk.⁽⁴⁻⁸⁾

The objective of this review is to synthesize recent evidence on the management of complicated acute cholecystitis, with a practical approach aimed at clinical decision-making in general surgery, emergency, interventional gastroenterology, interventional radiology, and critical care services.

METHODS

A narrative literature review of publications from January 2021 to April 2026 was developed. PubMed/MEDLINE, PubMed Central, JAMA Network, EClinicalMedicine, SpringerLink, ScienceDirect, and open-access editorial databases were consulted. The search terms included: acute cholecystitis, complicated acute cholecystitis, gangrenous cholecystitis, perforated cholecystitis, early laparoscopic cholecystectomy, difficult gallbladder, subtotal cholecystectomy, percutaneous cholecystostomy, endoscopic ultrasound-guided gallbladder drainage, transpapillary gallbladder drainage, antibiotic therapy, and source control.

Systematic reviews, meta-analyses, international consensus statements, clinical guidelines, high-impact narrative reviews, and recent comparative studies were prioritized. Publications unrelated to acute gallbladder disease, articles focused exclusively on uncomplicated cholelithiasis, isolated reports without conceptual contribution, and literature prior to 2021 were excluded, except when a historical concept was indispensable to contextualize current practice. Given the narrative design, no meta-analysis or formal risk-of-bias assessment using a standardized tool was performed.

RESULTS

Clinical definition and phenotypes of complicated acute cholecystitis

From a pathophysiological standpoint, obstruction of the cystic duct produces gallbladder distension, increased intraluminal pressure, microvascular compromise, and mucosal damage. Bacterial translocation and the systemic inflammatory response may accelerate progression to necrosis, perforation, or sepsis, especially in older, diabetic, immunosuppressed patients or those with advanced cardiovascular, renal, or hepatic disease.^(1,2)

Identification of the clinical-radiological phenotype is essential because it modifies the urgency, type of source control, and threshold for indicating a bailout strategy. Abdominal ultrasound is usually the initial study; however, contrast-enhanced computed tomography provides more information when perforation, collections, emphysema, hepatic abscess, ileus, associated pancreatitis, or an uncertain differential diagnosis is suspected. Magnetic resonance cholangiography and endoscopic retrograde cholangiopancreatography are reserved for suspected choledocholithiasis, cholangitis, or relevant ductal abnormalities (Table 1).^(2,3)

Table 1. Clinical-radiological phenotypes and therapeutic implications.

Phenotype	Key findings	Preferred management	Alternative in high-risk patients
Gangrenous or empyematous	Persistent pain, fever, leukocytosis, thickened wall, mural hypoperfusion, purulent content or necrosis.	Early laparoscopic cholecystectomy with a low threshold for bailout technique.	Percutaneous cholecystostomy if instability, uncontrolled sepsis, or prohibitive anesthetic risk is present.
Emphysematous	Intramural or intraluminal gas, higher frequency in diabetes, rapid septic progression.	Urgent source control, broad-spectrum antibiotic therapy, and cholecystectomy if the patient is operable.	Percutaneous drainage as a bridge in critically ill patients.
Localized perforation or abscess	Perivesicular or hepatic collection, inflammatory phlegmon, persistent localized pain.	Cholecystectomy with drainage of the collection when technically safe.	Percutaneous drainage of the gallbladder and/or collection, followed by reassessment for interval cholecystectomy.
Free perforation with biliary peritonitis	Diffuse peritonitis, free fluid, sepsis, and hemodynamic deterioration.	Lavage, drainage, and urgent cholecystectomy if the condition permits.	Damage control and drainage in extremely unstable patients.

Initial management principles

Initial treatment should be simultaneous and not sequential: hemodynamic stabilization, pain control, correction of fluid and electrolyte disorders, blood cultures when fever or sepsis is present, empirical antibiotic therapy adjusted to severity, and early surgical evaluation. Delayed source control increases the risk of progression to necrosis, perforation, bacteremia, and organ dysfunction.^(2,18)

Antibiotic therapy does not replace source control. In mild or moderate cases undergoing cholecystectomy with adequate control, prolonged postoperative regimens usually do not provide benefit. In severe disease, bacteremia, perforation, abscess, sepsis, or incomplete source control, treatment must be individualized, with de-escalation according to cultures and clinical course. Recent recommendations suggest limiting duration to short courses after adequate control, with a usual maximum of four days in controlled severe scenarios, except in cases of persistent infection or additional complications.^(18,19)

The choice of antimicrobial agent should cover Enterobacterales and anaerobes when perforation, abscess, nosocomial infection, or high risk of resistant microorganisms is present. In critically ill patients, those with previous antibiotic exposure, biliary prostheses, cholangitis, sepsis, or recent health care exposure, initial coverage should be broadened and adjusted according to local epidemiology and bile or blood cultures.

Early laparoscopic cholecystectomy

Early laparoscopic cholecystectomy during hospital admission remains the preferred definitive strategy in patients with sufficient physiological reserve. Recent evidence shows that, compared with delayed surgery, the early approach is associated with shorter total hospital stay, reduced

recurrence, and lower need for readmission, without a clinically relevant increase in complications when performed by trained teams.^(3,4)

The concept of early surgery should not be interpreted rigidly as an absolute 72-hour window. Although intervention in the early phases of the disease usually facilitates source control, multiple contemporary reviews support that cholecystectomy during the same admission may be appropriate even after this period when the patient is operable, surgical availability exists, and the anatomy can be approached safely.⁽²⁻⁴⁾

In complicated cholecystitis, the surgical decision should integrate hemodynamic stability, organ dysfunction, comorbidities, frailty, coagulopathy, advanced cirrhosis, suspicion of ductal injury or neoplasia, imaging availability, and surgeon experience. The objective is not to complete a total cholecystectomy at any cost, but to achieve source control without injury to the main bile duct or vascular damage.

Difficult gallbladder, critical view of safety, and bailout strategies

The difficult gallbladder is characterized by severe inflammation of the hepatocystic triangle, fibrosis, edema, necrosis, inflammatory phlegmon, dense adhesions, or anatomical alteration. In these cases, bile duct injury usually occurs when unsafe dissection is maintained with erroneous identification of the common bile duct or common hepatic duct as the cystic duct. Therefore, obtaining the critical view of safety must be an explicit goal before clipping or dividing structures.^(6,20)

When the critical view cannot be achieved, bailout strategies should be used. Laparoscopic subtotal cholecystectomy allows part of the gallbladder to be resected and the infection controlled while avoiding dangerous dissection of the hilum. It may be fenestrating, when the gallbladder remnant is left open with drainage, or reconstituting, when the remnant is closed. Recent meta-analyses indicate that the fenestrating technique may be associated with greater bile leakage, whereas the reconstituting technique may increase the risk of symptomatic remnant or recurrence; therefore, the choice should be based on anatomy, inflammation, experience, and the possibility of safe closure.⁽⁶⁻⁹⁾

Other bailout maneuvers include a fundus-first approach, conversion to open surgery, intraoperative cholecystostomy, external drainage, and transfer to a hepatobiliary team. Conversion to open surgery should not be considered a failure, but it does not guarantee safety if biliary anatomy remains distorted.

Percutaneous cholecystostomy

Percutaneous cholecystostomy consists of image-guided drainage of the gallbladder, usually through a transhepatic or transperitoneal approach. Its main indication is the patient with complicated or severe acute cholecystitis who presents high surgical risk, instability, sepsis, organ dysfunction, decompensated comorbidity, or a temporary contraindication to general anesthesia.⁽¹⁰⁻¹⁴⁾

Recent evidence has refined its role. In patients with acceptable risk, cholecystectomy continues to show better overall outcomes than isolated cholecystostomy, including lower mortality and lower readmission in contemporary meta-analyses. Therefore, cholecystostomy should not be used as a routine substitute for surgery in operable patients, but as a source-control strategy in those who cannot tolerate an immediate intervention.^(11,12)

After cholecystostomy, the patient should be reassessed in a planned manner. If the clinical condition improves and anesthetic risk becomes acceptable, interval cholecystectomy reduces the risk of recurrence and new admissions. Recent consensus suggest considering delayed surgery at least six weeks after drainage in appropriate candidates, whereas in patients who are not surgical candidates, definitive management with the tube, removal after tract maturation and assessment of patency, or close surveillance may be considered depending on the context.⁽¹³⁾

The limitations of cholecystostomy include catheter displacement, bile leakage, bleeding, pain, need for exchanges, tube obstruction, recurrent infections, and persistent gallstones as a recurrence factor. The decision to remove the drain should be individualized, usually after clinical resolution, reduction of inflammatory markers, and confirmation of a mature tract or cystic duct patency when deemed necessary.^(13,14)

Endoscopic gallbladder drainage

Endoscopic gallbladder drainage has gained relevance as a minimally invasive alternative in patients who are not candidates for surgery. There are two main modalities: transpapillary drainage by endoscopic retrograde cholangiopancreatography, with stent placement through the cystic duct, and endoscopic ultrasound-guided drainage, usually using lumen-apposing metal stents.⁽¹⁵⁻¹⁷⁾

Endoscopic ultrasound-guided drainage avoids an external catheter, provides internal drainage, and may reduce reinterventions compared with percutaneous drainage in highly experienced centers. The American Gastroenterological Association clinical practice update recognizes it as a feasible and effective alternative in high-risk surgical candidates, provided it is performed by endoscopists experienced in therapeutic endoscopic ultrasound and within a multidisciplinary team.⁽¹⁵⁾

Transpapillary drainage is useful when there is a simultaneous indication for cholangiopancreatography due to choledocholithiasis or cholangitis, or when endoscopic ultrasound access is not appropriate. Its main limitation is dependence on cystic duct patency and a lower technical success rate than endoscopic ultrasound drainage in some scenarios.^(16,17)

Auxiliary technologies

Robotic surgery has been explored in urgent cholecystectomy because of its ergonomics, optical stability, and instrumental precision. However, its superiority over conventional laparoscopy in complicated cholecystitis has not been conclusively demonstrated, and its implementation depends on costs, availability, learning curve, and emergency logistics. At present, it should be considered a possible platform in trained centers, not a mandatory standard.

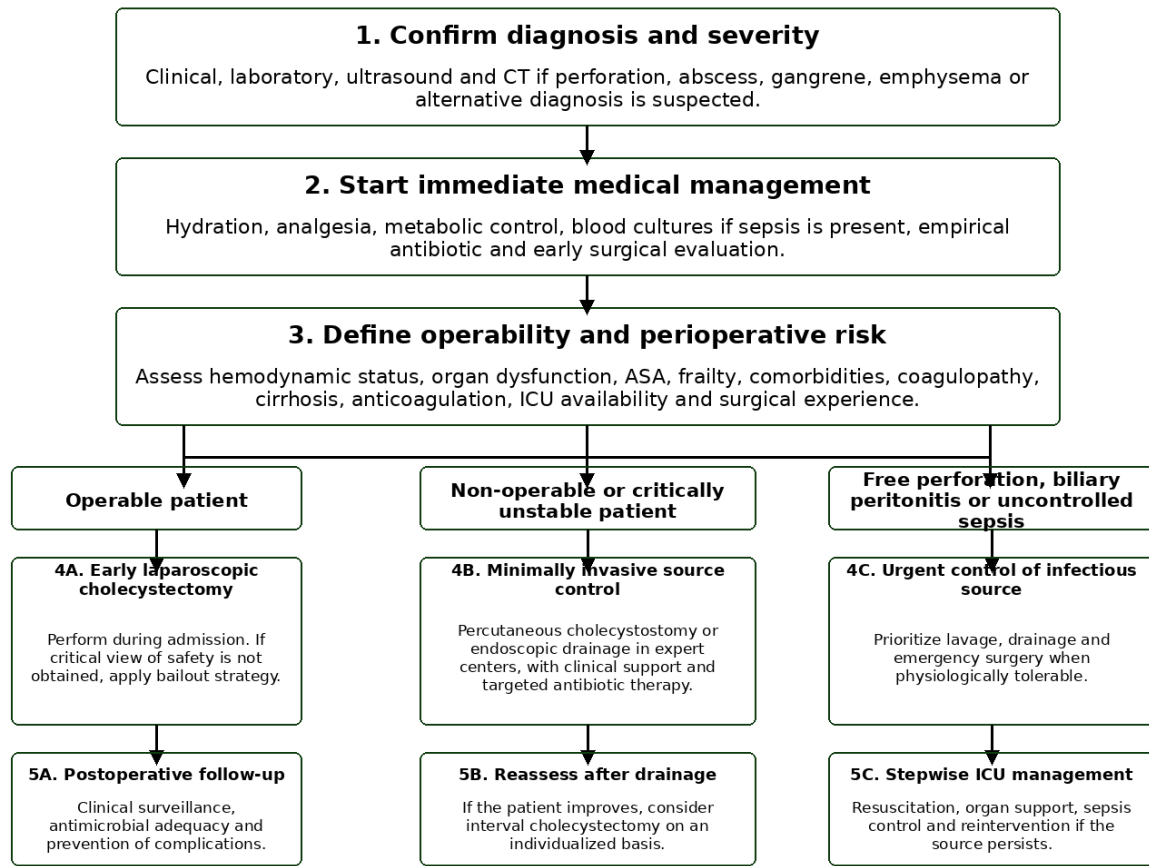
Indocyanine green fluorescence allows real-time visualization of extrahepatic biliary structures and may be useful in selected patients. Recent meta-analyses suggest that it improves anatomical identification, although its performance decreases when intense inflammation, obesity, gangrene, or dense fibrous tissue is present. Therefore, it should be used as a safety adjunct, not as authorization for unsafe dissection.^(21,22)

Therapeutic algorithm for complicated acute cholecystitis

Stepwise approach according to clinical severity, operability, and need for urgent control of the infectious source (Figure 1)

Therapeutic algorithm for complicated acute cholecystitis

Stepwise approach according to clinical severity, operability, and source control



Special considerations

In geriatric patients, chronological age alone should not be a contraindication for surgery. The decision should be based on frailty, functional status, cardiopulmonary reserve, anesthetic risk, and goals of care. In diabetes and immunosuppression, a low threshold for computed tomography and early source control is recommended because of the higher risk of gangrene, emphysema, and bacteremia. In advanced cirrhosis or non-correctable coagulopathy, percutaneous or endoscopic drainage may be a temporary or definitive alternative. When choledocholithiasis or cholangitis is suspected, the bile duct should be evaluated with liver profile, magnetic resonance cholangiography, endoscopic ultrasound, or ERCP according to pretest probability.

DISCUSSION

Recent evidence converges on a central principle: complicated acute cholecystitis requires early source control, but the method must be adapted to patient risk and local anatomy. Early laparoscopic cholecystectomy continues to be the strongest definitive treatment for operable patients. However, insisting on completing a total cholecystectomy under unsafe conditions can turn a treatable disease into a bile duct injury with high morbidity. Therefore, the concept of safe surgery has displaced the concept of complete surgery as an absolute priority.

Percutaneous cholecystostomy remains indispensable in high-risk patients, but its overuse in potentially operable patients may be associated with recurrence, readmissions, and delayed definitive treatment. Recent meta-analyses favor cholecystectomy when it is physiologically

possible, whereas consensus statements recommend interpreting cholecystostomy as a bridge or as a definitive alternative only in selected patients.⁽¹¹⁻¹³⁾

Endoscopic ultrasound-guided drainage represents one of the fastest-growing areas. Its conceptual advantage is providing internal drainage and avoiding the problems of an external catheter. However, reproducibility of its results depends on specialized training, prosthesis availability, multidisciplinary support, and appropriate selection. In regions with limited resources, percutaneous cholecystostomy will continue to be the most accessible drainage method.

The main limitation of the current literature is the heterogeneity of populations and definitions. Many studies include uncomplicated and complicated acute cholecystitis in the same analysis, with variability in severity, comorbidity, surgical technique, institutional experience, and success criteria. Consequently, recommendations should be interpreted as decision guides and not as substitutes for clinical judgment.

CONCLUSIONS

Current management of complicated acute cholecystitis is based on early source control, individualized risk stratification, and prevention of bile duct injuries. Early laparoscopic cholecystectomy during admission remains the treatment of choice in operable patients. In difficult gallbladder, the critical view of safety and bailout strategies, especially subtotal cholecystectomy, are essential to reduce major complications.

Percutaneous cholecystostomy maintains a relevant role in patients with prohibitive surgical risk or instability, but it should be accompanied by reassessment for interval cholecystectomy when the clinical condition allows it. Endoscopic gallbladder drainage, particularly endoscopic ultrasound-guided drainage, constitutes a promising alternative in specialized centers. The optimal approach requires collaboration among surgery, anesthesiology, gastroenterology, interventional radiology, infectious diseases, and critical care.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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