JAMA Surgery | Review

Indications for and Optimal Management of Percutaneous Cholecystectomy Drainage
A Systematic Review

Aymen H. Sadaka, BS; Jennifer F. Tseng, MD, MPH; Kamal M. F. Itani, MD

IMPORTANCE Use of percutaneous cholecystostomy (PC) has increased over the past 20 years without consensus regarding indications and management.

OBJECTIVE To identify indicators for PC, clarify the management of a PC tube (PCT), and suggest the timing of further interventions.

EVIDENCE REVIEW A systematic review was conducted to identify studies examining PC. Five databases were selected and searched from inception to December 31, 2024: PubMed, Embase, Cochrane, ICTRP, and ClinicalTrials.gov. Inclusion criteria were prior systematic reviews and meta-analyses published within the last 5 years, randomized clinical trials, prospective cohort studies, retrospective cohorts, cross-sectional studies, and case-control studies with multivariate analyses.

FINDINGS Of 3774 publications identified, 69 studies met the inclusion criteria. There were 5 randomized clinical trials, 2 prospective cohort analyses, 40 retrospective cohort analyses, 1 case-control study, 12 cross-sectional studies, 3 systematic reviews, and 6 meta-analyses. PC was outperformed by cholecystectomy and offered no apparent benefit compared to antibiotic-only management (AOM) except among patients with concomitant sepsis. Interval cholecystectomy (IC) following PC was associated with better outcomes compared to a definitive PC. Factors associated with failure to undergo IC include congestive heart failure (CHF) and chronic liver disease (CLD). IC within 8 weeks and beyond 13 weeks after PC was associated with increased complications. Removal of PC before IC was associated with reduced complications but an increase in the likelihood of undergoing emergency IC. A PCT clamp trial was a better test than tube cholangiogram for PCT removal.

CONCLUSION AND RELEVANCE PC should only be considered among poor surgical candidates unable to undergo immediate cholecystectomy. Indications for PC include cholecystitis sepsis or AOM failure. PC should be approached as a bridging therapy to IC with careful consideration among patients with CHF and CLD. PC removal before IC should be guided by a successful clamping trial to reduce complications and interim recurrence. IC should be performed 8 to 13 weeks after PC.

JAMA Surg. doi:10.1001/jamasurg.2025.3260
Published online September 3, 2025.

Supplemental content

CME at jamacmelookup.com

Author Affiliations: Department of Surgery, Veterans Affairs Boston Health Care System, Boston, Massachusetts (Sadaka, Itani); Boston University School of Medicine, Boston, Massachusetts (Sadaka, Tseng, Itani); Harvard Medical School, Boston, Massachusetts (Itani).

Corresponding Author: Kamal M. F. Itani, MD, Department of Surgery, Veterans Affairs Boston Healthcare System, 1400 VFW Pkwy, West Roxbury, MA 02132 (kamal.itani@va.gov).

Acute cholecystitis (AC) is a common condition caused by localized inflammation surrounding the gallbladder, most frequently caused by cholelithiasis. In contrast to acute calculous cholecystitis (ACC), acute acalculous cholecystitis (AAC) is seen in critically ill patients and is caused by gallbladder-emptying dysfunction.

The Tokyo Guidelines, updated in 2018, classify the severity of AC into 3 grades (I-III), defined by clinical presentation, laboratory values, imaging, and the presence of organ dysfunction, and help guide management. The gold standard treatment of AC, regardless of pathophysiology, is cholecystectomy (CC). According to the Tokyo Guidelines, patients with neurological dysfunction, respiratory dysfunction, a Charlson Comorbidity Index (CCI) score of 4 or greater, and American Society of Anesthesiologists Physical Status (ASA-PS) score of 3 or greater are poor surgical candidates and should undergo a cooling-off period with percutaneous cholecystostomy (PC) or antibiotic-only management (AOM) before CC.[1] Over time, PC has evolved from a bridge to CC into an alternative definitive management for AC for patients who remain poor surgical candidates.

The use of PC has grown substantially over the past 2 decades, especially during the COVID-19 pandemic.[2] However, there is uncertainty regarding the indication and management of PC, as indicated in the 2024 Delphi consensus, in which 6 of 27 statements reached consensus.[3] This systematic review aims to address areas of uncertainty regarding PC, using the best available evidence, by identifying patients who should be considered for PC, clarifying the management of a PC tube (PCT), and suggesting the timing of further interventions.

Methods

A systematic review of the medical literature following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline was conducted on December 31, 2024, to identify studies examining the current indications, maintenance, and outcomes of PC. Two databases, including PubMed/MEDLINE and Embase, and 3 registries, including Cochrane Central Register of Controlled Trials, ClinicalTrials.gov, and the International Clinical Trials Registry Platform (ICTRP), were searched.

The following search strategy was initially developed in PubMed by A.H.S. and K.M.F.I. using combinations of keywords: on one side *cholecystostomy* and on the other side *indication*, *maintenance*, *duration*, *cholecystectomy*, or *cholecystitis*. No filters based on human participation, publication date, or article type were initially used to ensure a comprehensive review and inclusion of all relevant articles. This strategy was translated to the other search engines. Results were entered into Rayyan, a software platform using artificial intelligence and natural language processing to aid in systematic reviews.[4] Duplicates were removed by Rayyan and by hand. Titles and abstracts were screened by A.H.S. and K.M.F.I. with the remaining articles undergoing full-text review according to our inclusion criteria.

Randomized clinical trials (RCTs) and prospective cohort studies were included. Retrospective cohort, case-control, and cross-sectional studies that performed multivariate analyses, alongside systematic reviews and meta-analyses conducted within the past 5 years, were also included. Case studies, case series, and opinion pieces were excluded. To determine patients who might be ideal candidates for PC, articles that compared mortality between PC and CC, PC and AOM, and interval CC (IC) and definitive PC were collected alongside predictors of IC. To clarify the management of PC and the timing of further interventions, articles that examined postoperative complications (primary outcome of conversion to open) during IC and articles that examined recurrence among definitive PC were collected.

The quality of evidence was determined by A.H.S. and K.M.F.I. and rated according to the Oxford Center for Evidence-Based Medicine guidelines, which assigns the most robust data a value of 1 and the least robust data a value of 5.

Key Points

Question When is percutaneous cholecystostomy (PC) indicated and how should it be managed?

Findings In this systematic review, PC was outperformed by cholecystectomy and offered no apparent benefit compared to antibiotic-only management except among patients with concomitant sepsis. A clamp trial was superior to tube cholangiogram when considering tube removal, and laparoscopic interval cholecystectomy (IC) 8-13 weeks following PC was associated with better outcomes compared to a definitive PC.

Meaning The findings suggest that PC should be used as a bridge to IC and should be considered among patients who will likely become good surgical candidates.

Results

A total of 3774 articles were identified across 5 platforms. After removing duplicates, irrelevant articles, and articles that did not meet the inclusion criteria, 69 remained (**Figure 1**) with an average Oxford grading of 2.74. Among these, there were 5 RCTs, 2 prospective cohort analyses, 40 retrospective cohort analyses, 1 case-control study, 12 cross-sectional studies, 3 systematic reviews, and 6 meta-analyses.

PC vs CC

This review identified 13 studies, 2 systematic reviews, and 4 meta-analyses that compared mortality between PC and CC (eTable 1 in the Supplement) with an average Oxford grading of 2.58. One RCT was identified and found no differences in mortality among patients with ACC and Acute Physiology And Chronic Health Evaluation (APACHE) scores 7 to 14; however, PC was associated with increased recurrence, reintervention, and complications.[5] There were no RCTs comparing PC and CC among patients with AAC. Among observational studies, PC was either associated with higher mortality[6-12] or demonstrated no difference.[13-17] Three of the 4 meta-analyses and systematic reviews demonstrated an increased mortality rate with PC.[18-23]

PC vs AOM

This review identified 14 studies that compared outcomes between PC and AOM (eTable 2 in the Supplement) with an average Oxford grading of 3.07. No meta-analyses or systematic reviews were identified. One RCT demonstrated no difference in mortality rates among patients with APACHE scores greater than 12,[24] while a retrospective cohort found improved survival with PC among patients with APACHE scores greater than 10.[25] Results were inconsistent with 4 studies demonstrating lower mortality and improved resolution of symptoms associated with PC,[2,26-28] 5 demonstrating no differences between PC and AOM,[12,13,29-31] and 3 demonstrating increased mortality with PC.[8,32,33]

When specifically examining PC among patients with severe AC (defined as Tokyo Guidelines grade III), 1 study found that PC was associated with increased mortality.[32] In contrast, 2 other studies found no differences in mortality,[30,31] with 1 of them showing an association between PC and reduced sepsis and thrombotic and respiratory complications.[31] Another study found that PC was associated with increased mortality among patients with AC, but the association no longer existed when comparing patients with sepsis.[8] Among nonsevere AC, earlier PC (within 24 hours) was associated with successful treatment.[27] Another study demonstrated that treatment with PC 7 days after diagnosis was associated with increased mortality.[30]

Definitive PC vs IC

This review identified 7 studies that compared outcomes between patients who underwent IC to those who had PC as a definitive management (eTable 3 in the Supplement) with an average Oxford grading of 3.00. No systematic reviews, meta-analyses, or RCTs were identified. Among these studies, 48% of patients eventually underwent IC. Six of the 7 studies demonstrated improved survival among patients who underwent IC,[8,9,34-37] while 1 found no difference.[38]

Factors Associated With Undergoing IC

This review identified 12 studies that determined factors associated with IC following PC (eTable 4 in the Supplement) with an average Oxford grading of 3.08. No systematic reviews, meta-analyses, or RCTs were identified. Among these studies, 41% of patients underwent IC. Identified variables associated with IC in individual studies were included in **Table 1**, and all studies were reviewed to determine if those variables were included. The percentage of studies that found an association between the variable of interest when examined are included. Variables that demonstrated an association with a failure of undergoing IC in more than 50% of studies were an elevated CCI score,[39-42] elevated Elixhauser Comorbidity Index,[43] elevated Tokyo Guidelines grades,[39,42,44] lower albumin,[42,44] congestive heart failure, and chronic liver disease.[9,43] The remaining identified variables were less predictive.

IC Conversion and Complications

This review identified 7 studies and 1 meta-analysis that compared conversion to open surgery or complications among patients undergoing IC (eTable 5 in the Supplement) with an average Oxford grading of 1.88. Two RCTs and 1 meta-analysis found that IC following PC was associated with decreased conversion,[48,49] biliary duct injury,[48] and postoperative complications[49] compared to emergency CC without prior temporizing measures.[50] Another RCT found no association between PC and conversion rates when comparing IC after PC or AOM.[51] However, 2 retrospective cohort analyses found PC was associated with increased conversion[52,53] and biliary duct injury.[53]

Two studies examined complications among patients who underwent IC with PCT preserved (in situ) or removed (ex situ). One study found that PCT in situ had significantly increased conversion rates and postoperative complications.[54] Another study found no differences in IC complications between PCT in situ and PCT ex situ but noted that patients undergoing PCT ex situ were more likely to have an emergency IC.[55] Among patients who had a PCT removed, having a patent cholangiogram (CCG) did not influence perioperative and postoperative IC outcomes including conversion rates.[55]

Timing of IC

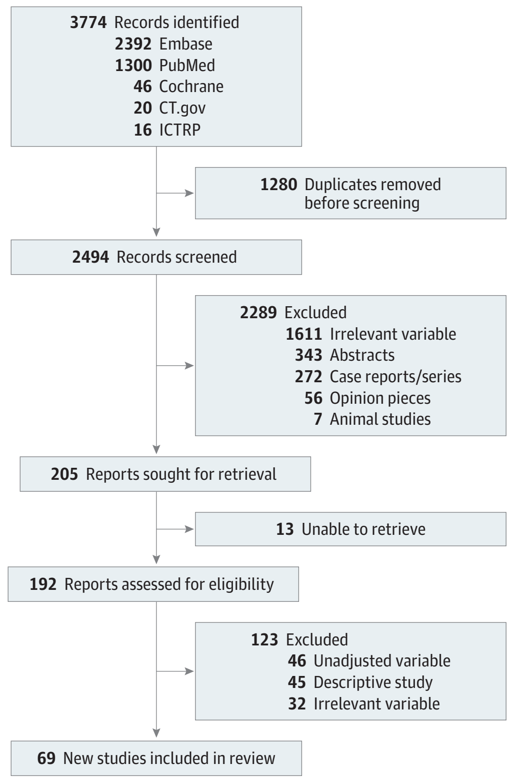
This review identified 8 studies and 1 meta-analysis that attempted to determine the optimal timing of IC (eTable 6 in the Supplement) with an average Oxford score of 3.00. No RCTs were identified. Two studies suggested that a shorter interval, within 5 days, from PC to surgery during initial hospitalization was associated with reduced morbidity.[56,57]

Among patients discharged with a PCT, IC beyond 13 weeks[58] and within 8 weeks[59] was associated with increased complications. Another study found that IC within 1 month was associated with increased mortality and surgical complications.[60] No differences in post-IC outcomes among various time intervals were found in the remaining studies.[61-63] The meta-analysis found no difference in mortality or morbidity between IC within and beyond 30 days of PC.[64]

Recurrence After PC as Definitive Management

This review identified 9 studies and 1 systematic review that explored PC as definitive management (eTable 7 in the Supplement) with an average Oxford grading of 2.91. No RCTs or meta-analyses were identified. Among these studies, 16% of patients had a recurrence. Identified variables associated with recurrence in individual studies are included in **Table 2**, and all studies were reviewed to determine if they included those variables. Four of the studies included patients who had their PCT removed, and the remaining studies neither specified nor included tube removal in their analyses.

Figure 1. PRISMA Diagram of Study Selection



Variables that demonstrated an association with increased recurrence in more than 50% of studies were elevated alkaline phosphatase,[37] congestive heart failure,[65,66] and underlying malignancy.[66,67] Duration of PC was associated with recurrence in 3 of 7 studies; however, results were varied and inconsistent.[39,67,68] Patency on CCG and subsequent recurrence lacked association in all studies that examined CCG.[36,67,69] Successful clamping trial was associated with reduced recurrence in 1 study,[67] and the prior systematic review favors clamping before PCT removal.[70]

Discussion

The use of PC has risen over the past decade, as has its approach as definitive management, without consensus.[3] This systematic review aims to clarify the indications and management of PC by providing an evidence-based algorithm (**Figure 2**). An average Oxford score of 2.74 indicates a need for more robust research and limits the strength of the provided recommendations. To highlight this need for more research, the tan boxes in Figure 2 indicate areas in management that are particularly lacking strong evidence.

This review highlights that CC was associated with decreased mortality and reduced complications regardless of AC severity, pathophysiology, and comorbidities.[5,20-22] CC is the gold standard for treat

Table 1. Identified Variables Associated With Interval Cholecystectomy Across All 12 Studies

Source	Study design	Variable[a]																
		Age	ACC	CCI score	ECI score	ASA score	TG	ALP	Alb	Tbili	SIRS	AD	CHF	CLD	Diabetes	Cancer	Resp	CKD
Sanaiha et al,[9] 2020	Retro cohort	No	NR	NR	No	NR	NR	NR	NR	NR	NR	NR	Yes	Yes	No	No	No	No
Bhatt et al,[36] 2018	Retro cohort	No	No	No	NR	NR	NR	No	NR	No	NR	NR	NR	NR	NR	NR	NR	NR
Pang et al,[37] 2016	Retro cohort	Yes	No	NR	NR	No	No	No	NR	No	No	Yes	NR	NR	No	No	Yes	No
Wang et al,[39] 2016	Retro cohort	Yes	NR	Yes	NR	NR	Yes	NR	NR	NR	NR	Yes	NR	NR	NR	NR	NR	NR
Abdelsaid et al,[40] 2023	Retro cohort	No	Yes	Yes	NR	NR	NR	No	NR	No	NR	No	NR	NR	No	No	No	NR
Lau et al,[41] 2023	Retro cohort	No	NR	Yes	NR	Yes	NR	NR	NR	Yes	NR	NR	NR	NR	NR	NR	Yes	NR
Colonna et al,[42] 2019	Retro cohort	No	No	Yes	NR	No	Yes	No	Yes	No	NR	NR	NR	NR	NR	NR	NR	NR
Pavurala et al,[43] 2019	Cross-sectional	Yes	NR	NR	Yes	NR	NR	NR	NR	NR	No	No	Yes	Yes	No	NR	No	No
Yao et al,[44] 2021	Retro cohort	No	Yes	NR	NR	NR	Yes	NR	Yes	No	No	No	NR	No	No	Yes	NR	No
Bala et al, 2016[45]	Retro cohort	Yes	NR	NR	NR	NR	NR	Yes	No	No	Yes	Yes	No	No	No	NR	No	No
Jang et al,[46] 2015	Retro cohort	Yes	No	No	NR	Yes	NR	No	NR	No	No	No	NR	NR	No	NR	NR	No
Yeo et al,[47] 2016	Retro cohort	No	NR	No	NR	No	No	NR	NR	NR	No	NR	NR	NR	NR	NR	NR	NR
Association percentage when variable included in respective study, %	NA	41.7	33.3	57.1	50.0	40.0	60.0	16.6	66.6	12.5	16.6	42.8	66.6	50.0	0.0	25.0	33.3	0.0

Abbreviations: ACC, acute calculous cholecystitis; AD, atherosclerotic disease (myocardial infarction, peripheral vascular disease, cerebrovascular disease, and hypertension); alb, albumin; ALP, alkaline phosphatase; ASA, American Society of Anesthesiologist; CCI, Charlson Comorbidity Index; CHF, congestive heart failure; CKD, chronic kidney disease.; CLD, chronic liver disease; ECI, Elixhauser Comorbidity Index; resp, respiratory dysfunction; NA, not applicable; NR, not reported; retro, retrospective; SIRS, systemic inflammatory response syndrome; tbili, total bilirubin; TG, Tokyo Guideline.

[a] Yes indicates a significant association with interval cholecystectomy; no, no significant association.

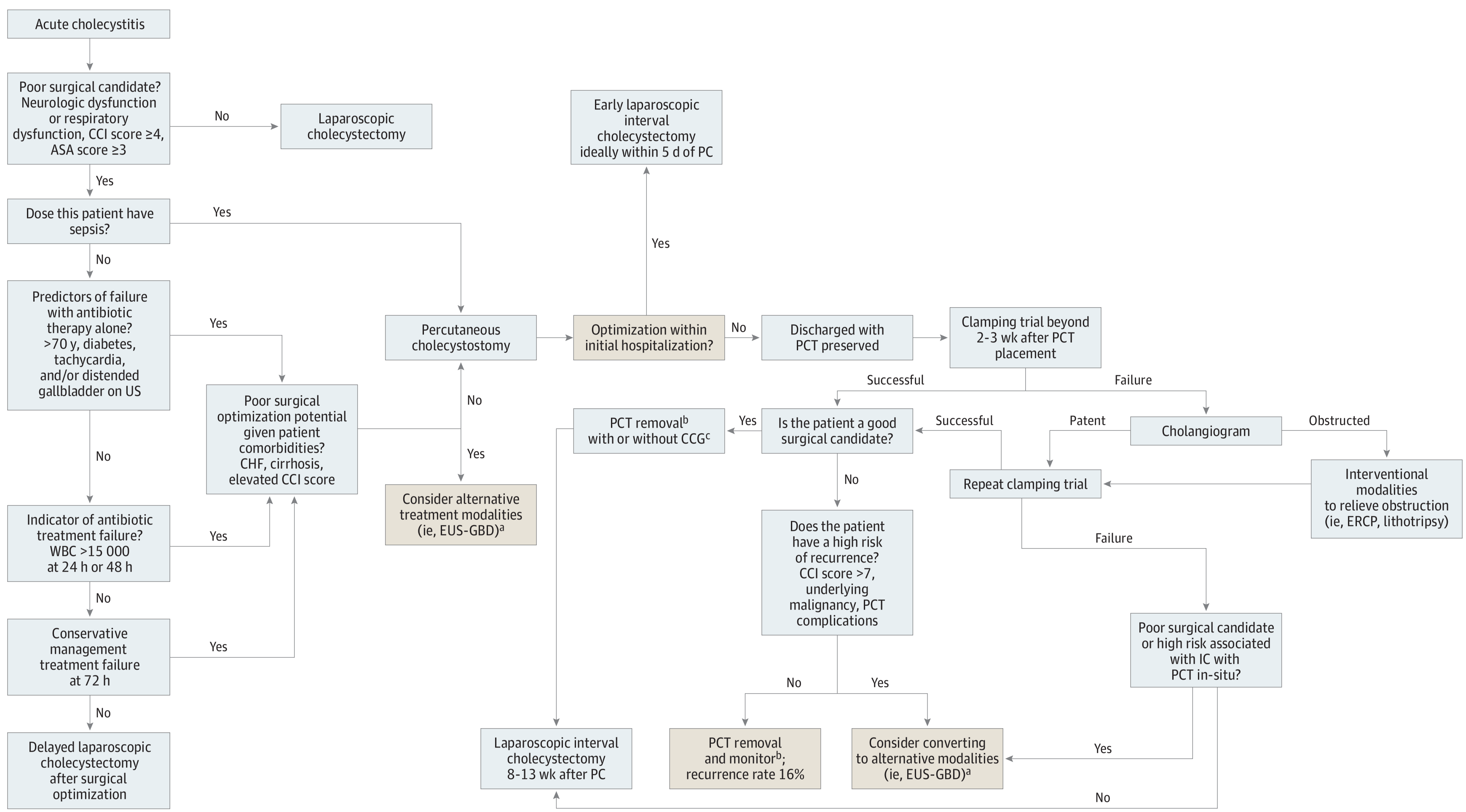
Table 2. Identified Variables Associated With AC Recurrence Following PC Across All 9 Studies

Source	Study design	Variable[a]													
		ACC	CCI score	PCTD	PCTC	CCG	SCT	ALP	PCL	Lipase	CRP	AD	CHF	Diabetes	Cancer
PCT ex situ															
Park et al,[67] 2019	Cross-sectional	Yes	NR	Yes	NR	No	Yes	NR	NR	NR	NR	No	NR	No	Yes
Heo et al,[69] 2022	Retro cohort	No	No	No	Yes	No	No	NR	NR	NR	No	NR	NR	NR	NR
Tuncer et al,[71] 2023	Retro cohort	No	NR	No	NR	NR	NR	NR	Yes	Yes	NR	NR	NR	NR	NR
NR	Retro cohort	NR	Yes	No	NR	NR	NR	NR	NR	NR	No	No	No	No	No
Unspecified															
Bhatt et al,[36] 2018	Retro cohort	Yes	NR	No	NR	No	NR	NR	NR	NR	NR	NR	NR	NR	NR
Pang et al,[37] 2016	Retro cohort	No	NR	NR	NR	NR	NR	Yes	NR	NR	NR	Yes	NR	NR	NR
Wang et al,[39] 2016	Retro cohort	NR	NR	Yes	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Chen et al,[65] 2021	Retro cohort	NR	No	NR	NR	NR	NR	NR	NR	NR	NR	No	Yes	No	No
Fleming et al,[66] 2019	Retro cohort	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Yes	Yes	Yes	Yes
Hsieh et al,[68] 2012	Retro cohort	NR	NR	Yes	NR	NR	NR	No	NR	NR	Yes	NR	NR	No	NR
Association percentage when variable included in respective study, %	NA	40.0	33.3	42.9	100.0	0.0	50.0	50.0	100.0	100.0	33.3	40.0	66.6	20.0	50.0

Abbreviations: ACC, acute calculous cholecystitis; AD, atherosclerotic disease (myocardial infarction, peripheral vascular disease, cerebrovascular disease, and hypertension); ALP, alkaline phosphatase; CCG, cholangiogram; CCI, Charlson Comorbidity Index; CHF, congestive heart failure; CRP, C-reactive protein; NA, not applicable; NR, not reported; PCL, procalcitonin; PCTC, percutaneous cholecystostomy tube complication; PCTD, percutaneous cholecystostomy tube duration; retro, retrospective; SCT, successful clamping trial.

[a] Yes indicates a significant association with recurrence; no, no significant association.

Figure 2. Proposed Algorithm of Indication for and Management of Percutaneous Cholecystostomy



ASA indicates American Society of Anesthesiologists score; CCG, cholangiogram; CCI, Charlson Comorbidity Index; CHF, congestive heart failure; EUS-GBD, endoscopic ultrasound gallbladder drainage; IC, interval cholecystectomy; PC, percutaneous cholecystostomy; PCT, percutaneous cholecystostomy tube; US, ultrasonography; WBC, white blood cell count.

[a] EUS-GBD is an evolving area of cholecystitis management that requires more data.

[b] Timing of PCT, particularly relative to IC, requires more research.

[c] Use of clamping trial over cholangiogram as the main indication for PCT removal warrants further investigation.

ing AC, and PC should only be considered for patients with contraindications for surgery, such as neurological dysfunction, respiratory dysfunction, a CCI score of 4 or greater, or an ASA-PS score of 3 or greater, as identified in the Tokyo Guidelines.[1] No studies specifically identified which patients should undergo PC; however, this review has identified indications and contraindications for the procedure by using factors associated with undergoing IC and recurrence to help with management.

The only consistent indication for PC identified in this review is AC sepsis, as PC was associated with improved resolution of symptoms and reduced complications with comparable mortality rates to AOM in patients with sepsis.[8,31] Otherwise, PC has not demonstrated consistent superiority or inferiority over AOM in nonsevere cases and can be approached as an alternative treatment option when AOM fails. Importantly, identifying when AOM fails may influence outcomes, as early and timely PC is associated with improved outcomes[27] and delay may be associated with increased mortality.[30] One study identified age greater than 70 years, diabetes, tachycardia, and distended gallbladder at admission as factors associated with AOM failure, and white blood cell count greater than 15 000 cells/μL at 24 and 48 hours of observation to be associated with AOM failure.[73] These factors may be considered as potential indicators to provide early PC. However, more robust research on when PC should be performed after AOM fails is warranted.

IC was associated with reduced mortality compared to definitive CC.[8,9,34-37] Therefore, we recommend PC be approached as a bridge to CC rather than definitive treatment. This review identified factors associated with failure of undergoing IC, including elevated CCI, congestive heart failure, and chronic liver disease.[9,43] If patients are unlikely to be optimized for IC, we recommend considering alternative treatment modalities, such as endoscopic ultrasound-guided gallbladder drainage (EUS-GBD).[74]

PC may be an independent risk factor of conversion to open surgery,[52,53] likely due to the difficulty in establishing the critical view of safety. If the patient is optimized during initial hospitalization, a shorter interval, ideally within 5 days, between PC and IC was associated with reduced complications and morbidities.[56,57] For patients discharged with an indwelling PCT, IC within 8 to 13 weeks after PC is associated with reduced complications.[58,59] Although PC removal before IC may be protective against complications, it was also associated with an increased likelihood of undergoing emergency IC for recurrent cholecystitis.[54,55] Management of indwelling PCT becomes a balance between IC complications and recurrence.

All studies that looked at cholangiography prior to PCT removal demonstrated no association with patency of the cystic duct and recurrence of cholecystitis.[36,67,69] Additionally, a patent cholangiogram was not associated with perioperative and postoperative IC outcomes.[55] One of the 2 studies that examined clamping trials defined failure of a clamping trial as the recurrence of symptomatology, which was also associated with increased recurrence of cholecystitis.[67,69] The utility of CCG for PC management is therefore questionable, and more robust research is warranted. Priority for a clamping trial over CCG before PCT removal may be considered and, if successful, a PCT can be removed with or without CCG. If the clamping trial fails, a CCG may be considered to detect signs of obstruction with a repeat clamping trial after appropriate intervention. If the second clamping trial fails, a risk-benefit analysis regarding IC with PCT in situ should be conducted, given the associated increase in IC complications. If the patient has a high risk of complications during the procedure, or otherwise remains a poor surgical candidate, conversion to permanent endoscopic drainage may be considered if available. If the patient has a successful clamping trial and is a good candidate for surgery, we recommend PCT removal followed by IC.

We recognize that patients who undergo PC with the intent of IC may never become optimal surgical candidates. Currently, there is a lack of data on the permanent maintenance of PCT; however, PC is associated with complications, such as dislodgement and occlusion, which can lead to recurrence of cholecystitis.[69] Therefore, for patients who remain poor surgical candidates and have successful clamping, we recommend an evaluation of recurrence risk factors. ACC and AAC were not consistently associated with recurrence,[37,69,71] and consideration for removal can be based on more reliable predictors, such as a CCI score greater than 7, underlying malignancy, and PCT complications,[67,69,72] rather than pathophysiology. For patients with more risk factors, conversion to permanent endoscopic drainage may be considered if available. For patients with a low risk of recurrence, PCT removal without further intervention may be appropriate.

Several areas remain unknown in the management of AC among nonsurgical candidates. For example, the timing of PCT removal to minimize recurrence and improve surgical outcomes remains unclear. There is a lack of robust data to provide any appropriate recommendations. The later date of either resolution of symptoms or sinus tract maturation, typically occurring at 2 to 3 weeks,[75] can be considered for PCT removal. Furthermore, this systematic review could not identify any studies that examined the timing of recurrence after PCT removal, a metric we believe is vital to determine when removal should be performed relative to IC.

Additionally, EUS-GBD is an evolving area in the management of AC. Although it has demonstrated improved technical success, fewer adverse events, and lower reintervention rates when compared to PC,[74] EUS-GBD is a novel procedure with limited availability and concerns for complicated IC. We recognize its benefits for the definitive management of AC in poor surgical candidates who are unable to be optimized for IC—a role where PC is inferior. However, we continue to recommend the use of PC for patients who will undergo IC as more data accumulate regarding EUS-GBD.

Limitations

Although we used the most robust data available, most of the studies consisted of retrospective cohort studies, with the average Oxford grading for these studies reaching 2.74. This, alongside heterogeneity between studies, limits the strength of the recommendations provided.

Conclusions

CC is the gold standard treatment for AC, and PC should be considered among poor surgical candidates with concomitant sepsis or those for whom AOM was unsuccessful. PC should be approached as a bridge to IC rather than definitive management. Careful consideration regarding who should undergo PC should be based on the patients' potential to become good surgical candidates. Interval laparoscopic CC should be performed within 8 to 13 weeks after PC removal guided by a successful clamping trial. More robust research is warranted, particularly regarding the maintenance of permanent PCT, ideal PCT indwelling time, and recurrence after PCT removal.

ARTICLE INFORMATION

Accepted for Publication: July 9, 2025.

Published Online: September 3, 2025. doi:10.1001/jamasurg.2025.3260

Author Contributions: Mr Sadaka and Dr Itani had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Sadaka, Itani.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Sadaka, Itani.
Critical review of the manuscript for important intellectual content: All authors.
Obtained funding: Itani.
Administrative, technical, or material support: Sadaka, Itani.
Supervision: Tseng, Itani.

Conflict of Interest Disclosures: None reported.

REFERENCES

1. Okamoto K, Suzuki K, Takada T, et al. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. *J Hepatobiliary Pancreat Sci*. 2018;25(1):55-72. doi:10.1002/jhbp.516

2. Wadhwa V, Trivedi PS, Makary MS, et al. Utilization and outcomes of cholecystostomy and cholecystectomy in patients admitted with acute cholecystitis: a nationwide analysis. *AJR Am J Roentgenol*. 2021;216(6):1558-1565. doi:10.2214/AJR.20.23156

3. Ramia JM, Serradilla-Martín M, Villodre C, et al; PERCHODEL Collaborative Study Group. International Delphi consensus on the management of percutaneous choleystostomy in acute cholecystitis (E-AHPBA, ANS, WSES societies). *World J Emerg Surg*. 2024;19(1):32. doi:10.1186/s13017-024-00561-8

4. Johnson N, Phillips M. Rayyan for systematic reviews. *J Electron*. 2018;30(1):46-48. doi:10.1080/1941126X.2018.1444339

5. Loozen CS, van Santvoort HC, van Duijvendijk P, et al. Laparoscopic cholecystectomy versus percutaneous catheter drainage for acute cholecystitis in high risk patients (CHOCOLATE): multicentre randomised clinical trial. *BMJ*. 2018;363:k3965. doi:10.1136/bmj.k3965

6. Vedachalam S, Jalil S, Krishna SG, et al. Call for action: Increased healthcare utilization with growing use of percutaneous cholecystectomy tube over initial cholecystectomy in cirrhotics. *Hepatobiliary Pancreat Dis Int*. 2022;21(1):56-62. doi:10.1016/j.hbpd.2021.07.008

7. Anderson JE, Chang DC, Talamini MA. A nationwide examination of outcomes of percutaneous cholecystostomy compared with cholecystectomy for acute cholecystitis, 1998-2010. *Surg Endosc*. 2013;27(9):3406-3411. doi:10.1007/s00464-013-2924-5

8. Anderson JE, Inui T, Talamini MA, Chang DC. Cholecystostomy offers no survival benefit in patients with acute acalculous cholecystitis and severe sepsis and shock. *J Surg Res*. 2014;190(2):517-521. doi:10.1016/j.jss.2014.02.043

9. Sanaiha Y, Juo YY, Rudasill SE, et al. Percutaneous cholecystostomy for grade III acute cholecystitis is associated with worse outcomes. *Am J Surg*. 2020;220(1):197-202. doi:10.1016/j.amjsurg.2019.11.025

10. Lu P, Chan CL, Yang NP, Chang NT, Lin KB, Lai KR. Outcome comparison between percutaneous cholecystostomy and cholecystectomy: a 10-year population-based analysis. *BMC Surg*. 2017;17(1):130. doi:10.1186/s12893-017-0327-6

11. Schlottmann F, Gaber C, Strassle PD, Patti MG, Charles AG. Cholecystectomy vs. cholecystostomy for the management of acute cholecystitis in elderly patients. *J Gastrointest Surg*. 2019;23(3):503-509. doi:10.1007/s11605-018-3863-1

12. Hanna K, Zangbar B, Kirsch J, et al. Non-operative management of cirrhotic patients with acute calculous cholecystitis: how effective is it? *Am J Surg*. 2023;226(5):668-674. doi:10.1016/j.amjsurg.2023.07.019

13. Marziali I, Cicconi S, Marilungo F, et al. Role of percutaneous cholecystostomy in all-comers with acute cholecystitis according to current guidelines in a general surgical unit. *Updates Surg*. 2021;73(2):473-480. doi:10.1007/s13304-020-00897-1

14. Zehetner J, Degnera E, Olasky J, et al. Percutaneous cholecystostomy versus laparoscopic cholecystectomy in patients with acute cholecystitis and failed conservative management: a matched-pair analysis. *Surg Laparosc Endosc Percutan Tech*. 2014;24(6):523-527. doi:10.1097/SLE.0b013e31829015d2

15. Simorov A, Ranade A, Parcells J, et al. Emergent cholecystostomy is superior to open cholecystectomy in extremely ill patients with acalculous cholecystitis: a large multicenter outcome study. *Am J Surg*. 2013;206(6):935-940. doi:10.1016/j.amjsurg.2013.08.019

16. Loftus TJ, Collins EM, Dessaigne CG, et al. Percutaneous cholecystostomy: prognostic factors and comparison to cholecystectomy. *Surg Endosc*. 2017;31(11):4568-4575. doi:10.1007/s00464-017-5517-x

17. Abi-Haidar Y, Sanchez V, Williams SA, Itani KM. Revisiting percutaneous cholecystostomy for acute cholecystitis based on a 10-year experience. *Arch Surg*. 2012;147(5):416-422. doi:10.1001/archsurg.2012.135

18. Ullah N, Kannan V, Ahmed O, et al. Effectiveness and safety of cholecystectomy versus percutaneous cholecystostomy for acute cholecystitis in older and high-risk surgical patients: a systematic review. *Cureus*. 2024;16(9):e70537. doi:10.7759/cureus.70537

19. Terrone A, Di Martino M, Saeidi S, Ranucci C, Di Saverio S, Giuliani A. Percutaneous cholecystostomy in elderly patients with acute cholecystitis: a systematic review and meta-analysis. *Updates Surg*. 2024;76(2):363-373. doi:10.1007/s13304-023-01736-9

20. Cirocchi R, Amato L, Ungania S, et al. Management of acute cholecystitis in high-risk patients: percutaneous gallbladder drainage as a definitive treatment vs. emergency cholecystectomy-systematic review and meta-analysis. *J Clin Med*. 2023;12(15):4903. doi:10.3390/jcm12154903

21. Huang H, Zhang H, Yang D, Wang W, Zhang X. Percutaneous cholecystostomy versus emergency cholecystectomy for the treatment of acute calculous cholecystitis in high-risk surgical patients: a meta-analysis and systematic review. *Updates Surg*. 2022;74(1):55-64. doi:10.1007/s13304-021-01081-9

22. Markopoulos G, Mulita F, Kehagias D, Tsochatzis S, Lampropoulos C, Kehagias I. Outcomes of percutaneous cholecystostomy in elderly patients: a systematic review and meta-analysis. *Prz Gastroenterol*. 2021;16(3):188-195. doi:10.5114/pg.2020.100658

23. Crucitti A, La Greca A, Pepe G, et al. Percutaneous cholecystostomy in the treatment of acute cholecystitis: is there still a role? a 20-year literature review. *Eur Rev Med Pharmacol Sci*. 2020;24(20):10696-10702.

24. Hatzidakis AA, Prassopoulos P, Petinarakis I, et al. Acute cholecystitis in high-risk patients: percutaneous cholecystostomy vs conservative treatment. *Eur Radiol*. 2002;12(7):1778-1784. doi:10.1007/s00330-001-1247-4

25. Jiang H, Guo G, Yao Z, Wang Y. APACHE IV system helps to determine role of cholecystostomy in elderly patients with acute cholecystitis. *J Int Med Res*. 2021;49(11):3000605211059288. doi:10.1177/03000605211059288

26. Lin D, Wu S, Fan Y, Ke C. Comparison of laparoscopic cholecystectomy and delayed laparoscopic cholecystectomy in aged acute calculous cholecystitis: a cohort study. *Surg Endosc*. 2020;34(7):2994-3001. doi:10.1007/s00464-019-07091-4

27. Wang CH, Wu CY, Lien WC, et al. Early percutaneous cholecystostomy versus antibiotic treatment for mild and moderate acute cholecystitis: a retrospective cohort study. *J Formos Med Assoc*. 2019;118(5):914-921. doi:10.1016/j.jfma.2018.09.018

28. Santos D, Ledet CR, Limmer A, Gibson H, Badgwell B. Use of non-operative treatment and interval cholecystectomy for cholecystitis in patients with cancer. *Trauma Surg Acute Care Open*. 2020;5(1):e000439. doi:10.1136/tsaco-2020-000439

29. Turiño SY, Shabanzadeh DM, Eichen NM, Jørgensen SL, Sørensen LT, Jørgensen LN. Percutaneous cholecystostomy versus conservative treatment for acute cholecystitis: a cohort study. *J Gastrointest Surg*. 2019;23(2):297-303. doi:10.1007/s11605-018-4021-5

30. Hazan D, Leibovitz E, Jazmawi M, Shimonov M. Does percutaneous cholecystostomy affect prognosis of patients with acute cholecystitis that are unresponsive to conservative treatment? *Saudi J Gastroenterol*. 2023;29(6):376-380. doi:10.4103/sjg.sjg_87_23

31. Curry J, Chervu N, Cho NY, et al. Percutaneous cholecystostomy tube placement as a bridge to cholecystectomy for grade III acute cholecystitis: a national analysis. *Surg Open Sci*. 2024;18:6-10. doi:10.1016/j.sopen.2024.01.006

32. Dimou FM, Adhikari D, Mehta HB, Riall TS. Outcomes in older patients with grade III cholecystitis and cholecystostomy tube placement: a propensity score analysis. *J Am Coll Surg*. 2017;224(4):502-511.e1. doi:10.1016/j.jamcollsurg.2016.12.021

33. Wiggins T, Markar SR, Mackenzie H, et al. Evolution in the management of acute cholecystitis in the elderly: population-based cohort study. *Surg*

Endosc. 2018;32(10):4078-4086. doi:10.1007/s00464-018-6092-5

34. Ragatha R, Khalil I, Jones R, et al. Clinical evolution of gallstones following percutaneous cholecystostomy in patients with severe acute calculous cholecystitis: a single-center analysis of 102 cases. *Ann Gastroenterol*. 2024;37(6):718-725. doi:10.20524/aog.2024.0915

35. Hess GF, Sedlaczek P, Haak F, et al. Persistent acute cholecystitis after cholecystostomy—increased mortality due to treatment approach? *HPB (Oxford)*. 2022;24(6):963-973. doi:10.1016/j.hpb.2021.11.006

36. Bhatt MN, Ghio M, Sadri L, et al. Percutaneous cholecystostomy in acute cholecystitis—predictors of recurrence and interval cholecystectomy. *J Surg Res*. 2018;232:539-546.42. doi:10.1016/j.jss.2018.06.051

37. Pang KW, Tan CHN, Loh S, et al. Outcomes of percutaneous cholecystostomy for acute cholecystitis. *World J Surg*. 2016;40(11):2735-2744.45. doi:10.1007/s00268-016-3585-z

38. Cha BH, Song HH, Kim YN, et al. Percutaneous cholecystostomy is appropriate as definitive treatment for acute cholecystitis in critically ill patients: a single center, cross-sectional study. *Korean J Gastroenterol*. 2014;63(1):32-38. doi:10.4166/kjg.2014.63.1.32

39. Wang CH, Wu CY, Yang JCT, et al. Long-term outcomes of patients with acute cholecystitis after successful percutaneous cholecystostomy treatment and the risk factors for recurrence: a decade experience at a single center. *PLoS One*. 2016;11(1):e0148017. doi:10.1371/journal.pone.0148017

40. Abdelsaid K, Hassan M, Jayasankar B, Jeilani M, Ali H, Abdul Aal Y. Percutaneous cholecystostomy in severe acute cholecystitis: an observational study from a single institute. *Cureus*. 2023;15(2):e34539. doi:10.7759/cureus.34539

41. Lau J, Sinha S. Outcome predictors of percutaneous cholecystostomy as definitive versus bridging treatment for acute cholecystitis. *Cureus*. 2023;15(12):e49962. doi:10.7759/cureus.49962

42. Colonna AL, Griffiths TM, Robison DC, et al. Cholecystostomy: are we using it correctly? *Am J Surg*. 2019;217(6):1010-1015. doi:10.1016/j.amjsurg.2019.04.002

43. Pavurala RB, Li D, Porter K, Mansfield SA, Conwell DL, Krishna SG. Percutaneous cholecystostomy-tube for high-risk patients with acute cholecystitis: current practice and implications for future research. *Surg Endosc*. 2019;33(10):3396-3403. doi:10.1007/s00464-018-06634-5

44. Yao P, Chang Z, Liu Z. Factors influencing failure to undergo interval cholecystectomy after percutaneous cholecystostomy among patients with acute cholecystitis: a retrospective study. *BMC Gastroenterol*. 2021;21(1):410. doi:10.1186/s12876-021-01989-x

45. Bala M, Mizrahi I, Mazeh H, Yuval J, Eid A, Almogy G. Percutaneous cholecystostomy is safe and effective option for acute calculous cholecystitis in select group of high-risk patients. *Eur J Trauma Emerg Surg*. 2016;42(6):761-766. doi:10.1007/s00068-015-0601-1

46. Jang WS, Lim JU, Joo KR, Cha JM, Shin HP, Joo SH. Outcome of conservative percutaneous cholecystostomy in high-risk patients with acute cholecystitis and risk factors leading to surgery. *Surg Endosc*. 2015;29(8):2359-2364. doi:10.1007/s00464-014-3961-4

47. Yeo CSW, Tay VWY, Low JK, Woon WWL, Punamiya SJ, Shelat VG. Outcomes of percutaneous cholecystostomy and predictors of eventual cholecystectomy. *J Hepatobiliary Pancreat Sci*. 2016;23(1):65-73. doi:10.1002/jhbp.304

48. El-Gendi A, El-Shafei M, Emara D. Emergency versus delayed cholecystectomy after percutaneous transhepatic gallbladder drainage in grade II acute cholecystitis patients. *J Gastrointest Surg*. 2017;21(2):284-293. doi:10.1007/s11605-016-3304-y

49. Karakayali FY, Akdur A, Kirnap M, Harman A, Ekici Y, Moray G. Emergency cholecystectomy vs percutaneous cholecystostomy plus delayed cholecystectomy for patients with acute cholecystitis. *Hepatobiliary Pancreat Dis Int*. 2014;13(3):316-322. doi:10.1016/S1499-3872(14)60045-X

50. Cirocchi R, Cozza V, Sapienza P, et al. Percutaneous cholecystostomy as bridge to surgery vs surgery in unfit patients with acute calculous cholecystitis: a systematic review and meta-analysis. *Surgeon*. 2023;21(4):e201-e223. doi:10.1016/j.surge.2022.12.003

51. Akyürek N, Salman B, Yüksel O, et al. Management of acute calculous cholecystitis in high-risk patients: percutaneous cholecystotomy followed by early laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech*. 2005;15(6):315-320. doi:10.1097/01.sle.0000191619.02145.c0

52. Sakran N, Kopelman D, Dar R, et al. Outcome of delayed cholecystectomy after percutaneous cholecystostomy for acute cholecystitis. *Isr Med Assoc J*. 2018;20(10):627-631.

53. Mizrahi I, Mazeh H, Yuval JB, et al. Perioperative outcomes of delayed laparoscopic cholecystectomy for acute calculous cholecystitis with and without percutaneous cholecystostomy. *Surgery*. 2015;158(3):728-735. doi:10.1016/j.surg.2015.05.005

54. Tomimaru Y, Fukuchi N, Yokoyama S, et al; Clinical Study Group of Osaka University, Hepato-Biliary-Pancreatic Group. Effect of preserving the percutaneous gallbladder drainage tube before laparoscopic cholecystectomy on surgical outcome: post hoc analysis of the CSGO-HBP-017. *J Gastrointest Surg*. 2022;26(6):1224-1232. doi:10.1007/s11605-022-05291-3

55. Hung YL, Chen HW, Fu CY, et al. Surgical outcomes of patients with maintained or removed percutaneous cholecystostomy before intended laparoscopic cholecystectomy. *J Hepatobiliary Pancreat Sci*. 2020;27(8):461-469. doi:10.1002/jhbp.740

56. Kujirai D, Isobe Y, Suzumura H, et al. Time from drainage to surgery is an independent predictor of morbidity for moderate-to-severe acute cholecystitis: a multivarirble analysis of 259 patients. *BMC Surg*. 2024;24(1):389. doi:10.1186/s12893-024-02688-6

57. Jia B, Liu K, Tan L, Jin Z, Fu Y, Liu Y. Evaluation of the safety and efficacy of percutaneous transhepatic gallbladder drainage combined with laparoscopic cholecystectomy for treating acute complicated cholecystitis. *Am Surg*. 2018;84(1):133-136. doi:10.1177/000313481808400134

58. Spaniolas K, Pryor A, Stefanidis D, et al. Multisociety research collaboration: timing of cholecystectomy following cholecystostomy drainage for acute cholecystitis. *Surg Endosc*. 2024;38(10):6053-6059. doi:10.1007/s00464-024-11145-7

59. Altieri MS, Yang J, Yin D, Brunt LM, Talamini MA, Pryor AD. Early cholecystectomy (≤8 weeks) following percutaneous cholecystostomy tube placement is associated with higher morbidity. *Surg Endosc*. 2020;34(7):3057-3063. doi:10.1007/s00464-019-07050-z

60. Woodward SG, Rios-Diaz AJ, Zheng R, et al. Finding the most favorable timing for cholecystectomy after percutaneous cholecystostomy tube placement: an analysis of institutional and national data. *J Am Coll Surg*. 2021;232(1):55-64. doi:10.1016/j.jamcollsurg.2020.10.010

61. Giannopoulos S, Makhecha K, Madduri S, Garcia F, Baumgartner TC, Stefanidis D. What is the ideal timing of cholecystectomy after percutaneous cholecystostomy for acute cholecystitis? *Surg Endosc*. 2023;37(11):8764-8770. doi:10.1007/s00464-023-10332-2

62. Noubani M, Sethi I, McCarthy E, et al. The impact of interval cholecystectomy timing after percutaneous transhepatic cholecystostomy on post-operative adverse outcomes. *Surg Endosc*. 2023;37(12):9132-9138. doi:10.1007/s00464-023-10451-w

63. Polito C, Zhang X, Yang J, Spaniolas K, Pryor A, Sbayi S. Timing of cholecystectomy following cholecystostomy tube placement for acute cholecystitis: a retrospective study aiming to identify the optimal timing between a percutaneous cholecystostomy and cholecystectomy to reduce the number of poor surgical outcomes. *Surg Endosc*. 2022;36(10):7541-7548. doi:10.1007/s00464-022-09193-y

64. Kourounis G, Rooke ZC, McGuigan M, Georgiades F. Systematic review and meta-analysis of early vs late interval laparoscopic cholecystectomy following percutaneous cholecystostomy. *HPB (Oxford)*. 2022;24(9):1405-1415. doi:10.1016/j.hpb.2022.03.016

65. Chen BQ, Chen GD, Xie F, Li X, Mao X, Jia B. Percutaneous cholecystostomy as a definitive treatment for moderate and severe acute acalculous cholecystitis: a retrospective observational study. *BMC Surg*. 2021;21(1):439. doi:10.1186/s12893-021-01411-z

66. Fleming MM, Liu F, Luo J, Zhang Y, Pei KY. Predictors of 30 day readmission following percutaneous cholecystostomy. *J Surg Res*. 2019;233:1-7. doi:10.1016/j.jss.2018.07.006

67. Park JK, Yang JI, Wi JW, et al. Long-term outcome and recurrence factors after percutaneous cholecystostomy as a definitive treatment for acute cholecystitis. *J Gastroenterol Hepatol*. 2019;34(4):784-790. doi:10.1111/jgh.14611

68. Hsieh YC, Chen CK, Su CW, et al. Outcome after percutaneous cholecystostomy for acute cholecystitis: a single-center experience. *J Gastrointest Surg*. 2012;16(10):1860-1868. doi:10.1007/s11605-012-1965-8

69. Heo J, Jung MK, Cho CM, et al. What makes acute cholecystitis recur after removing the percutaneous cholecystostomy tube? *Medicine (Baltimore)*. 2022;101(5):e28767. doi:10.1097/MD.0000000000028767

70. Hung YL, Sung CM, Fu CY, et al. Management of patients with acute cholecystitis after percutaneous cholecystostomy: from the acute stage to definitive surgical treatment. *Front Surg*. 2021;8:616320. doi:10.3389/fsurg.2021.616320

71. Tuncer K, Kilinc Tuncer G, Çalık B. Factors affecting the recurrence of acute cholecystitis after treatment with percutaneous cholecystostomy. *BMC Surg*. 2023;23(1):143. doi:10.1186/s12893-023-02042-2

72. Do YA, Yoon CJ, Lee JH, Choi WS, Lee CH. Percutaneous cholecystostomy as a definitive treatment for acute acalculous cholecystitis: clinical outcomes and risk factors for recurrent cholecystitis. *Br J Radiol*. 2023;96(1147):20220943. doi:10.1259/bjr.20220943

73. Barak O, Elazary R, Appelbaum L, Rivkind A, Almogy G. Conservative treatment for acute cholecystitis: clinical and radiographic predictors of failure. *Isr Med Assoc J*. 2009;11(12):739-743.

74. Lyu Y, Li T, Wang B, Cheng Y, Chen L, Zhao S. Endoscopic ultrasound-guided gallbladder drainage versus percutaneous transhepatic gallbladder drainage for acute cholecystitis with high surgical risk: an up-to-date meta-analysis and systematic review. *J Laparoendosc Adv Surg Tech A*. 2021;31(11):1232-1240. doi:10.1089/lap.2020.0786

75. Hatjidakis AA, Karampekios S, Prassopoulos P, et al. Maturation of the tract after percutaneous cholecystostomy with regard to the access route. *Cardiovasc Intervent Radiol*. 1998;21(1):36-40. doi:10.1007/s002709900208