Cholecystectomy versus percutaneous cholecystostomy drainage in critically ill patients with acute calculous syndrome: a comparative study

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Background
Acute calculous cholecystitis is a common disease presentation in critically ill patients. It is associated with increased mortality and morbidity rates in case of insufficient treatment. However, the best approach to management is still debatable.

Patients and methods
This is a retrospective analysis of prospectively designed study for the evaluation of different management planes in critically ill patients presented with acute cholecystitis in a single university hospital from 2013-2017. The study included all patients with acute cholecystitis as the main reason for patient deterioration and hospital admission and also those patients already admitted in hospital ICU and consulted other departments for symptoms of acute cholecystitis. Preoperative data and operative outcomes were analyzed.

Results
A total of 225 patients (median age68 years; range=57–91 years) were included. Overall, 28.9% (65 patients) underwent percutaneous cholecystostomy drainage (PCD), 34.2% (77 patients) underwent open cholecystectomy (OC), and 36.9% (83 patients) underwent laparoscopic cholecystectomy. The patients' demographics were comparable in all groups, except for age and BMI. Laparoscopic cholecystectomy was successful in 85.5% of patients. Nine patients in PCD group needed completion OC (13.8%). Preoperative comorbidities were similar in the studied groups. The postoperative infection was high in OC group (P=0.013). The overall mortality was 4%, with the highest value in the PCD group, and no significant difference was observed among all groups (0.197). Hospital and ICU stays were increased in the OC group (P=0.001).

Conclusion
Open and laparoscopic approaches are safe in critically ill patients and have comparable results to PCD. The advantage of disease eradication cannot be overlooked. The laparoscopic approach is better in the view of short hospital stay and infection rate.

Keywords:
acute cholecystitis, cholecystostomy laparoscopic cholecystectomy, Tokyo guidelines

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Introduction

Acute cholecystitis can be categorized into two distinct types: acute calculous cholecystitis and acute acalculous cholecystitis. The former type represents ~90% of all acute cholecystitis cases, whereas the latter type represents the remaining cases [1]. Currently, laparoscopic cholecystectomy (LC) is considered as the standard of care for acute cholecystitis [2]. However, in critically ill patients presented with acute calculus syndrome, the risk of postoperative complication is high; thus, a tailored approach for such high-risk patients is mandatory [3]. Percutaneous cholecystostomy drainage (PCD) is a well-documented option in such patients and can be used as a single procedure or as a preliminary step before cholecystectomy [4–6]. However, the procedure is still associated with high mortality and morbidity rates in comparison with immediate operative intervention [7]. The newly revised Tokyo guidelines based on diagnostic criteria and severity assessment of acute cholecystitis are now available along with a simple management plan, including PCD, open cholecystectomy (OC), and LC according to each grade [8]. The aim of this study was to evaluate and compare the outcomes of the different management modalities in critically ill patients with acute calculous syndrome with respect to the Tokyo guidelines.

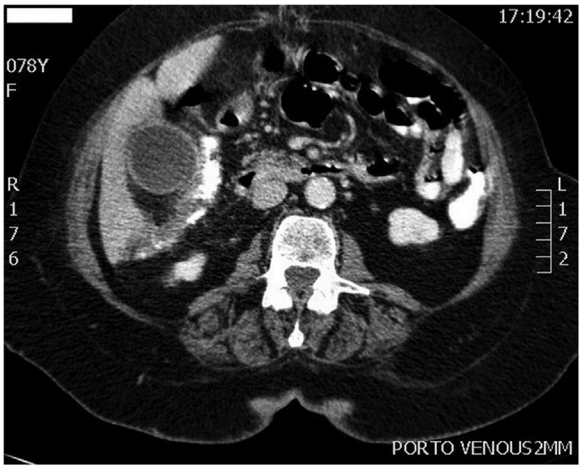
Patients and methods

This is a retrospective study of patients admitted to the surgical department in a single university hospital from February 2014 to September 2017. All critically ill patients presented with acute cholecystitis and who met the Tokyo Guidelines (TG13) diagnostic criteria were included in the study. Patients are graded according to TG13 severity assessment criteria (Table 1). Exclusion criteria included acute cholangitis, obstructive jaundice, and pancreatitis. The primary outcome of this study was the estimation of patient mortality during the admission and operative morbidity, whereas the secondary outcomes included readmission and length of hospital and ICU stay. Acute cholecystitis was suspected based on clinical presentation, patient's history (abdominal pain, fever, and positive Murphy's sign), laboratory findings, and radiological assessment with computed tomography and/or ultrasound imaging. Gallbladder wall thickness more than 4 mm and the presence of pericholecystic fluid were diagnostic (Table 2 and Figs 1, 2). On confirmed diagnosis, a broad-spectrum antibiotic with anaerobic covering was started. A planned intervention was implemented along with the optimization of associated comorbidities including intensive system support and ICU admission if indicated.

Patient's selection and management options

All patients were evaluated thoroughly by a multidisciplinary on-call team including surgeon,

Fig. 1



Acute cholecystitis with thick wall gallbladder.

Table 1 Severity classification of acute cholecystitis by the Tokyo guidelines 2013

Grade definition
I (mild): acute cholecystitis that does not meet the criteria for grade III or grade II cholecystitis
Acute cholecystitis in a healthy patient with no organ dysfunction. Inflammatory changes in the gallbladder are mild, making cholecystectomy a safe and low-risk procedure
II (moderate): grade II acute cholecystitis is associated with any one of the following conditions
1. Elevated white blood cell count (>18 000/mm^3)
2. Palpable tender mass in the right upper abdominal quadrant
3. Duration of complaints >72 h
4. Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis, and emphysematous cholecystitis)
III (severe): grade III acute cholecystitis associated with dysfunction of any one of the following organs/systems
1. Cardiovascular dysfunction defined as hypotension requiring treatment with dopamine ≥5 μg/kg/min or any dose of norepinephrine
2. Neurologic dysfunction defined as decreased level of consciousness
3. Respiratory dysfunction defined as a PaO_2/FiO_2 ratio <300
4. Renal dysfunction defined as oliguria or creatinine >2.0 mg/dl
5. Hepatic dysfunction defined as PT-INR >1.5
6. Hematologic dysfunction defined as platelet count <100 000/mm^3

Table 2 Diagnostic criteria for acute cholecystitis

A. Local signs of inflammation
(1) Murphy's sign and (2) right upper quadrant mass/pain/tenderness
B. Systemic signs of inflammation
(1) Fever, (2) elevated CRP, and (3) elevated WBC count
C. Imaging findings: imaging findings characteristic of acute cholecystitis
Definite diagnosis
(1) One item in A and one item in B are positive
(2) C confirms the diagnosis when acute cholecystitis is suspected clinically

WBC, white blood cells.

Fig. 2

Acute cholecystitis with pericholecystic fluid and thick gallbladder wall in a patient with multiple comorbidities.

Table 3 American Society of Anesthesiology risk index

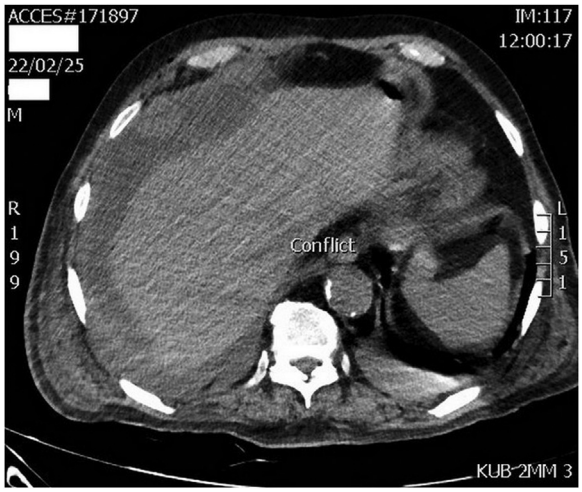
ASA 1 Normal, healthy
ASA 2 Mild systemic disease without functional limitation
ASA 3 Severe systemic disease with functional limitation
ASA 4 Life-threatening severe systemic disease
ASA 5 Not expected to survive operation
ASA 6 Brain death
ASA E Emergency surgery

ASA, American Society of Anesthesiology.

intensivists, anesthesiologist, and interventional radiologists. While assessing the patients for responding to medical therapy, a decision was made about the final management plan. The patients were categorized to one of the three treatment options according the TG13 severity grade of the patients and American Society of Anesthesiologists (ASA) score [9] (Table 3), with ASA grades 3 and 4 patients primarily directed to PCD drainage as the first treatment option whereas other patients with a less ASA grade assigned to laparoscopic or open surgery according to the senior surgical decision.

Comparative results were assessed according to the received treatment: group A (PCD), group B (OC), or group C (LC). PCD was performed under radiological guidance with a percutaneous transhepatic route. Patients undergo PCD were followed up for procedure related complication, in

Fig. 3



A postoperative collection with bile leak after laparoscopic cholecystectomy, computed tomography-guided drainage done.

specific failure of patient's improvement as regard local abdominal and general signs (abdominal tenderness and rigidity, fever and inotrope support). If no improvement occurred within 48 hours, patient was booked for urgent OC with intraoperative removal of the catheter.

The patients' demographic data, including sex, age, BMI, and medical comorbidities, were assessed for each patient at the time of surgery. All laboratory and radiological data were recorded for each patient. Perioperative data including operative time, operative difficulties including the change of surgical plan, and the conversion rate were also recorded. As a protocol, if the patient does not respond to PCD or LC, OC was the preferred treatment. Postoperative complications including further intervention, ICU, and hospital stay were also assessed (Fig. 3).

Statistical analysis

Data were collected using Excel for Windows 2013, and analysis was performed with the MedCalc program (MedCalc Statistical Software version 16.4.3, MedCalc Software bvba, Ostend, Belgium). The χ^2-test or Fisher's exact test was used for nominal variables as appropriate. The independent t-test was used to compare continuous variables. One-way analysis of the variance was used to compare the different groups. The P values less than 0.05 was considered significant.

Results

Among the 225 patients enrolled in this study, 79 (35.1%) patients were male, with a median age of 68 years (range: 57–91 years). The severity of acute

Table 4 Comparison of preoperative patient demographics

Variables	PCD (*n*=65)	OC (*n*=77)	LC (*n*=83)	*P* value
Age (years)	65.8±1.73.6	66.6±5.4	75±9.7	0.0001
Sex (female/male)	43/22	50/27	53/30	
BMI	26±0.4	26.4±0.7	24.8±0.6	0.001
Tokyo guidelines 2013 [*n* (%)]				
Grade II	52 (80)	60 (77.9)	61 (73.5)	
Grade III	13 (20)	17 (22.1)	22 (26.5)	0.652
Associated comorbidities				
Hypertension	8 (12.3)	8 (10.4)	7 (8.4)	0.74
Diabetes mellitus	4 (6.2)	5 (6.5)	8 (9.6)	0.66
Ischemic heart disease	3 (4.6)	2 (2.6)	1 (1.2)	0.47
Atrial fibrillation	4 (6.2)	4 (5.2)	3 (3.6)	0.44
Chronic obstructive airway disease	5 (7.7)	6 (7.8)	3 (3.6)	0.76
Renal insufficiency	4 (6.2)	5 (6.5)	3 (3.6)	0.68
Stroke	2 (3)	1 (1.3)	3 (3.6)	0.62

LC, laparoscopic cholecystectomy; OC, open cholecystectomy; PCD, percutaneous cholecystostomy drainage.

Table 5 Laboratory and radiological data in preoperative period

Variables	PCD	OC	LC	*P* value
White blood cells (10^3/μl)	23.2±0.23	21.6±1.13	26.2±1.9	0.001
Hemoglobin (g/dl)	12.9±0.34	14.4±0.8	15.1±0.47	0.367
Total bilirubin (mg/dl)	2.8±0.05	2.±0.08	2.3±0.14	
AST (IU/l)	78.7±2.5	74.8±6.1	86.5±4.2	
ALT (IU/l)	79.4±8.3	82.9±3.3	103±1.9	
ALP (IU/l)	292.4±11.2	375.6±8.8	440.8±35.9	
γ-GTP (IU/l)	116.4±9.2	104.4±10.6	180.5±8.8	
Thickened gallbladder wall (>4 mm)	5.4±0.44	5.3±0.65	5.4±0.7	

ALT, alanine aminotransferase ; ALP, alkaline phosphatase; AST, aspartate aminotransferase; LC, laparoscopic cholecystectomy; OC, open cholecystectomy; PCD, percutaneous cholecystostomy drainage.

cholecystitis was grade II in 173 (76.9%) patients and grade III in 52 (23.1%) patients, with no significant difference between the groups. Demographic data showed a difference between group C and other groups in terms of age presentation (*P*=0.001) and BMI (*P*=0.001). No parameter showed a difference among the groups, including the preoperative risk factors and associated comorbidities (Table 4). The main reason for ICU admission was associated comorbidities. Nine patients in group A underwent a completion OC (three patients showed no clinical response, one patient entered in biliary peritonitis, and five patients returned with severe abdominal pain). In group C, the rate of conversion was 14.5% (12 patients); one patient converted owing to bleeding and the others converted because of severe inflammatory adhesion and obscure surgical field. Table 5 shows that white blood cell (WBC) count and liver function tests were higher in group C; bilirubin level was higher in group A than in other groups (*P*=0.0001). Gallbladder wall thickness showed no significant difference among the three groups (*P*=0.35). Mean ICU admission and overall hospital admission were lower in group C (5.5±1.6 and 8.5±1.2, respectively) (*P*=0.001). Operative time was longer in group C (138.5±26.7) than group B (97.2±24.4) (*P*=0.001). Subtotal cholecystectomy was performed in three cases in group B and two cases in group C (Table 6). Table 7 shows the rate of postoperative complication, which shows no significant differences among groups including mortality rate during the same admission, except for postoperative infection, which was increased in group B (*P*=0.013). There was a correlation of WBC, gallbladder wall thickness, Tokyo grade, and BMI with conversion rate in the laparoscopic group (*P*=0.0006, 0.001, 0.024, and 0.033, respectively).

Discussion

Until now, there were limited studies comparing the different modalities of management of acute calculous cholecystitis in critically ill patients. Recently, many studies have evaluated certain treatment approaches and compared their results. In this study, we compared two surgical approaches including OC and LC to PCD with respect to preoperative and postoperative data and results. The main objective was to show the feasibility

Table 6 Operative outcomes

Variables	PCD [*n* (%)]	OC [*n* (%)]	LC [*n* (%)]	*P* value
Operative time		97.2±24.4		0.001
Intraoperative			138.5±26.7	
complication	0 (0)	0 (0)	1 (1.2)	0.42
Hemorrhage	0 (0)	0 (0)	2 (2.4)	0.176
Duct injury	9 (13.8)	0 (0)	12 (14.5)	0.0024
Conversion				
Subtotal		3 (3.9)	2 (2.4)	0.289
Cholecystectomy				
ICU admission	8.8±1.5	7.2±1.6	5.5±1.6	0.0001
Hospital stay (days)	13.2±2.45	11.8±2.6	8.5±1.2	0.0001

LC, laparoscopic cholecystectomy; OC, open cholecystectomy; PCD, percutaneous cholecystostomy drainage.

Table 7 Postoperative complication and mortality rate

Variables	PCD [*n* (%)]	OC [*n* (%)]	LC [*n* (%)]	*P* value
Bile leak	1 (1.5%)	0 (0)	2 (2.4)	0.178
Pneumonia	2 (3.1)	2 (2.6)	4 (4.8)	0.727
Infection	0	6 (7.8)	1 (1.2)	0.013
Cardiac ischemia	3 (4.6)	2 (2.6)	3 (3.6)	0.81
Mortality	5 (7.7)	2 (2.6)	2 (2.4)	0.197

LC, laparoscopic cholecystectomy; OC, open cholecystectomy; PCD, percutaneous cholecystostomy drainage.

of early surgical approach as the first line of treatment of such patients in our institution. According to TG13, three different categories of acute cholecystitis are present with different approaches for management. Grade I can be managed safely by the laparoscopic approach, grade II can be managed by either LC or PCD, and grade III patients can be managed by PCD only [8]. In our institution, PCD was the first-line approach for the treatment of critically ill patients with acute cholecystitis; however, in the study, 28.9% of patients underwent PCD, and the majority of the patients (71.1%) underwent surgical intervention. LC was the prime approach in our patients (36.9%), followed by OC (34.2%), which permitted a more precise comparison and procedure evaluation.

The reported rate of conversion ranged from 10.6 to 16% [10,11]. In our study, the rate of conversion was 14.5%. The main reasons for conversion were severe inflammation and adhesion, which obscured the anatomical landmark of safety found in 11 patients, and this correlates well with other studies [12–14].

In a recent study by Utsumi *et al.* [15], a correlation between several perioperative parameters, including previous surgery, the presence of pericholecystic fluid, acute cholecystitis, and emergent LC, and the rate of conversion was reported. They also stated that according to Tokyo 2013 guidelines for acute cholecystitis, the antiplatelet therapy or anticoagulant drug for the cardiovascular disease, previous upper abdominal surgery, and surgery by junior level were independent risk factors for conversion [15]. In our study, a correlation existed between preoperative WBCs and Tokyo grade with the conversion rate in all the groups (PCD required open surgery and LC, which converted intraoperative). Inoue *et al.* [2] studied the optimal time for cholecystectomy after drainage procedure and found the cut-off value for such interval was 9 days. They assumed that the operation can be done with fewer difficulties. In their study, only seven cases underwent the procedure in the first 72 h after drainage, so an assessment was not fully evaluated [2]. In our study, all converted patients in group A were done within 48 hours and none of the patients died in thissubgroup. The end point of the current study was the mortality rate along with ICU and hospital stay. We found that there was no significant difference in the overall mortality rates among the three groups (*P*=0786). However, the highest number of mortalities was in the PCD group (7.7%), and this result was comparable to other results [11]. In the current study, the ICU admission and hospital stay were shorter in the laparoscopic group in comparison with the other two groups. This finding is comparable to another study, which found that laparoscopic approach was associated with a decrease in both hospital stay and ICU admission and also the total direct cost compared with other groups [16].In conclusion, PCD, OC, and LC were the effective available options in the treatment of acute calculus diseases in critically ill patients. In the view of mortality rate and hospital stay, the laparoscopic approach is the preferred one; however, a significant conversion rate will be expected. OC is a good open option in the presence of gangrenous gallbladder or as completion after PCD.

There are several limitations of the current study. It is a retrospective study, and there are no clear inclusion

criteria to subgroup patients and randomize them to a specific intervention other than high risk and Tokyo guidelines. The small number in each group and the lack of long-term follow-up of patients who underwent PCD cannot be overlooked while estimating the exact percentage that may need operative intervention.

Compliance with ethical standards

Informed consent

Informed consent was obtained from all individual participants included in the study.

Human and animal rights statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Gulaya K, Desai SS, Sato K, Percutaneous cholecystostomy: evidence-based current clinical practice. Semin Intervent Radiol 2016; 1:291–296.

2 Inoue K, Ueno T, Nishina O, Douchi D, Shima K, Goto S, *et al.* Optimal timing of cholecystectomy after percutaneous gallbladder drainage for severe cholecystitis. BMC Gastroenterol 2017; 17:1–7.

3 Borzellino G, Sauerland S, Minicozzi AM, Verlato G, Di Pietrantonj C, de Manzoni G, Cordiano C. Laparoscopic cholecystectomy for severe acute cholecystitis. A meta-analysis of results. Surg Endosc 2008; 22:8–15.

4 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; 27:3406–3411.

5 Gangemi A, Danilkowicz R, Bianco F, Masrur M, Giulianotti PC. Risk factors for open conversion in minimally invasive cholecystectomy. JSLS J Soc Laparoendosc Surg 2017; 21:e2017.00062.

6 Huffman JL, Schenker S. Acute acalculous cholecystitis: a review. Clin Gastroenterol Hepatol 2010; 8:15–22.

7 Winbladh A, Gullstrand P, Svanvik J, Sandström P. Systematic review of cholecystostomy as a treatment option in acute cholecystitis. HPB 2009; 11:183–193.

8 Yokoe M, Takada T, Strasberg SM, Solomkin JS, Mayumi T, Gomi H. New diagnostic criteria and severity assessment of acute cholecystitis in revised Tokyo guidelines. J Hepatobiliary Pancreat Sci 2012; 19:578–585.

9 Owens WD, Felts JA, Spitznagel EL. ASA physical status classifications: a study of consistency of ratings. Anesthesiology 1978; 49:239–243.

10 Hall BR, Armijo PR, Krause C, Burnett T, Oleynikov D. Emergent cholecystectomy is superior to percutaneous cholecystostomy tube placement in critically ill patients with emergent calculous cholecystitis. Am J Surg 2017; 216:116–119.

11 Melloul E, Denys A, Demartines N, Calmes JM, Schäfer M. Percutaneous drainage versus emergency cholecystectomy for the treatment of acute cholecystitis in critically Ill patients: does it matter?. World J Surg 2011; 35:826–833.

12 Hutchinson CH, Traverso LW, Lee FT. Laparoscopic cholecystectomy. Do preoperative factors predict the need to convert to open?. Surg Endosc 1994; 8:875–880.

13 Sippey M, Grzybowski M, Manwaring ML, Kasten KR, Chapman WH, Pofah WE, *et al.* Acute cholecystitis: risk factors for conversion to an open procedure. J Surg Res 2015; 199:357–361.

14 Asai K, Watanabe M, Kusachi S, Matsukiyo H, Saito T, Kodama H, *et al.* Risk factors for conversion of laparoscopic cholecystectomy to open surgery associated with the severity characteristics according to the Tokyo guidelines. Surg Today 2014; 44:2300–2304.

15 Utsumi M, Aoki H, Kunitomo T, Mushiake Y, Yasuhara I, Taniguchi F, *et al.* Preoperative risk factors for conversion of laparoscopic cholecystectomy to open cholecystectomy and the usefulness of the2013 Tokyo Guidelines. Acta Med Okayama 2017; 71:419–425.

16 Hall BR, Armijo PR, Krause C, Burnett T, Oleynikov D, Emergent cholecystectomy is superior to percutaneous cholecystostomy tube placement in critically ill patients with emergent calculous cholecystitis. Am J Surg 2017; 216:11–14.