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Original Article

Risk factors affecting the success of percutaneous cholecystostomy treatment in high-risk patients with acute cholecystitis

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Abstract

Aim: The aim of study was to examine the results of percutaneous cholecystostomy (PC) in high-risk patients with acute cholecystitis (AC).

Material and Methods: In the retrospective study, records of patients with PC were examined. An American Society of Anesthesiologists (ASA) score was used for surgical risk. AC severity was evaluated according to Tokyo guidelines (TG) 18. TG 18 grade III, TG 18 grade II and I high surgical risk patients with AC were included in the study. Risk factors affecting the success of PC were investigated.

Results: Seventy patients were included in the study. The median folllow-up time was eight (1-119) months. The clinical success rate of PC and rate of recurrence were 85.7% and 10.0%, respectively. PC catheter-related complications were occurred at four patients. The mortality rate was 14.3%. An ASA ≥ IV score (p=0.005), chronic obstructive pulmonary disease (p=0.04), elevation in total bilirubin (p=0.02), and duration of PC <14 days (p <0.001) were found to be risk factors reducing the success of PC. In the logistic regression analysis, an ASA ≥ IV score (p=0.03) and duration of PC <14 days (p=0.005) were found to be independent risk factors reducing the success of PC.

Conclusion: PC can be used safely in high-risk patients with AC. The PC catheter should not be removed in <14 days and surgical treatment should be considered for patients with ASA ≥ IV score.

Keywords: Cholecystectomy; definitive treatment; efficacy; morbidity; mortality; percutaneous cholecystostomy

INTRODUCTION

Acute cholecystitis (AC) is a common disease, which presents with episodic pain in the epigastrium or right upper quadrant (RUQ) of the abdomen. Usually, emergent laparoscopic cholecystectomy (LC) is performed after antibiotics treatment (1). However, LC is associated with high morbidity and mortality in patients at high risk as reflected by e.g., old age, comorbidities, and complicated AC (2-4). Percutaneous cholecystostomy (PC) is an alternative treatment option for AC in high-risk patients (5-7). The Society of American Gastrointestinal and Endoscopic Surgeons guidelines recommend performing PC until cholecystectomy can be performed, while the Tokyo guidelines 18 (TG 18) stated that PC should be considered as the first alternative to surgical intervention (8,9). On the other hand, a Cochrane review published in 2013 could not provide any recommendation with regard to the use of PC in high-risk patients (10). Studies reported that PC can be used in high-risk patients with AC, however; some the risk factors affected its success (11-15).

In this study, we aimed to evaluate the efficacy of PC in high-risk patients with AC and the risk factors affecting its success in our clinic.

MATERIAL and METHODS

In our clinic, 1,177 patients with AC were treated between January 2013 and January 2020. The medical records of 88 patients who underwent PC for AC were screened. All patients with AC were classified into three groups according to the severity grade of the TG 18: grade I (mild), grade II (moderate), and grade III (severe) (16). An American Society of Anesthesiologists (ASA) score was used for surgical risk. ASA III and IV scores were accepted as high surgical risk. TG 18 grade II and I high-risk patients with AC, and TG 18 grade III patients with AC were included. To ensure the homogeneity of the study, patients who had developed cholecystitis during treatment for another reason in the intensive care unit (n=8), who had a symptom duration of ≥7 days (n=8), had decompensated

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liver failure (n=1), and those who were pregnant (n=1) were excluded. The median follow up time was eight (1-119) months. This retrospective study was approved by the Ethics Committee of Karadeniz Technical University (decision number: 2018/185). Informed consent was not obtained for the study.

The diagnosis of AC was made based on the clinical presentation of the patients (RUQ abdominal pain, fever, Murphy's sign), laboratory findings (elevated white blood cell [WBC] count and C-reactive protein [CRP] level), and imaging findings (thickening of the gallbladder [GB] wall, pericholecystic fluid collection, enlarged GB) (16). Fluid resuscitation was initiated in patients diagnosed with AC, and prophylactic analgesic and antibiotics treatment were administered. Patients who had stones in the common bile duct or cholangitis according to the imaging tests (ultrasonography [USG], magnetic resonance cholangiopancreatography [MRCP]) were evaluated with endoscopic retrograde pancreatography (ERCP). It was ensured that the patients did not have coagulopathy, had an international normalized ratio (INR) of < 1.5, and a platelet count > 50,000 before the PC. The decision on performing PC was made by the patient's attending surgeon. PC was performed by an interventional radiologist using a 6–10 pigtail catheter (Dawson-Mueller Drainage Catheter, Cook, Bloomington, IN) guided by USG and fluoroscopy through the transhepatic route. The microbiological samples were taken from the bile fluid of 25 patients. The drainage catheter was washed with 10 mL of saline daily. Antibiotics treatment was continued for at least 72 hours after PC. The success of PC was defined as resolution of symptoms and fever, and normalization of CRP levels and WBC counts. Failure of PC was defined as the persistence of symptoms and fever, and/or CRP levels and WBC counts that did not decrease or that continued to rise, and re-hospitalization due to the clinical manifestations of AC. Before removing the drainage catheter, it was investigated whether there was leakage, fistula, stones, or stenosis in the biliary tract with fluoroscopy. Patients who readmitted for new episode of cholecystitis during the follow-up period were evaluated for medical treatment, PC or surgical treatment. Emergent cholecystectomy was recommended for patients who failure PC at the first hospitalization, whereas interval cholecystectomy to the patients who PC successful.

Age, sex, presence of comorbidity, ASA scores, laboratory values, imaging findings, duration of PC, catheter-related complications, re-admission, postoperative complications, length of hospital stay, and mortality were recorded. SPSS (IBM Corp., Chicago, IL, USA) software version 22 was used for statistical calculations. The Shapiro–Wilk test was used to test for normality prior to the statistical calculations. Fisher's exact test, and the Mann–Whitney U test were used for categorical and continuous variables. Logistic regression analysis was performed for variables with a probability (p) value of < 0.05. A p-value of < 0.05 was considered statistically significant in all analyses.

RESULTS

Seventy patients were included in the study (Table 1). The median age of the patients was 74 (39-94) years. Hypertension (43/70, 61.4%), congestive heart failure (28/70, 40.0%), Type 2 Diabetes Mellitus (27/70, 38.6%), chronic obstructive pulmonary disease (COPD) (17/70, 24.3%), and coronary artery disease (16/70, 22.9%) were the most common comorbidities. According to TG 18, there were 33 AC patients (47.1%) in grade I, 32 AC patients (45.7&) in Grade II and five AC patients (7.2%) in Grade III. The median PC duration was 27 (2-98) days.

Table 1. Patients demography

Parameters	n=70
Age (years)	73.1±12.6, 74 (39-94)
Gender	
Female	14 (20.0)
Male	56 (80.0)
ASA score	
II	28 (40.0)
III	14 (20.0)
IV	28 (40.0)
Comorbidity (Yes)	70 (100.0)
Hypertension	43 (61.4)
Congestive heart failure	28 (40.0)
Diabetes Mellitus type 2	27 (38.6)
Chronic obstructive pulmonary disease	17 (24.3)
Coronary artery disease	16 (22.9)
Chronic kidney failure	12 (17.1)
Cerebrovascular accident	10 (14.3)
Acute kidney failure	6 (8.6)
Malignancy	5 (7.1)
Alzheimer disease	4 (5.7)
Labaratory values	
Alanine transaminase (U/L)	49.4±79.6, 20 (5-495)
Aspartate transaminase (U/L)	67.7±113.2, 26 (11-616)
Alkaline phosphatase (U/L)	174.7±216.9, 99 (42-1101)
Gamma glutamil transferase (U/L)	127.3±160.2, 58 (10-656)
Direct bilirubin (mg/dL)	0.9±1.8, 0.3 (0.1-9.1)
Total bilirubin (mg/dL)	1.9±3.0, 1.0 (0.3-15.7)
C-reactive protein (mg/L)	20.4±11.2, 21.6 (0.7-38.4)
Leukocyte (×10^3/μL)	14.7±6.8, 15.4 (3.0-31.4)
Imaging findings	
Calculous cholecystitis	66 (94.3)
Acalculous cholecystitis	4 (5.7)
Choledocholithiazis	8 (11.4)
Tokyo Guidelines 18	
Grade I	33 (47.1)
Grade II	32 (45.7)
Grade III	5 (7.2)
Duration of medical treatment (day)	2.9±2.7, 2 (1-13)
Duration of PC (day)	32.1±23.1, 27 (2-98)
PC catheter-related complications	
Bile leak	2 (2.9)
Catheter occlusion	2 (2.9)
Re-admission (Yes)	7 (10.0)
Lenght of hospital stay (day)	11.9 ±7.5, 10 (2-42)
Mortality (Yes)	12 (17.1)
Follow up (month)	28.0±33.0, 8 (1-119)

ASA: American Society of Anesthesiologists, Malignancy: Chronic myeloid leukemia, Lymphoma, Rectum cancer, Gastric cancer, Kaposi's sarcoma, PC: Percutaneous cholecystostomy

Table 2. Isolated bacteria from culture and applied antibiotic treatments in patients who percutaneous cholecystostomy

Parameters	n=70
Antibiotics treatment	70 (100.0)
Ceftriaxone	57 (81.4)
Piperacillin tazobactam	4 (5.7)
Vancomycin	4 (5.7)
Imipenem	3 (4.3)
Cefuroxime	1 (1.4)
Meropenem	1 (1.4)
Ciprofloxacin	1 (1.4)
Moxifloxacin	1 (1.4)
Ertapenem	1 (1.4)
Microorganism breeding in culture	25 (35.7)
Gram negative basilli	15 (60.0)
Escherichia coli	5 (20.0)
Klebsiella pneumoniae	5 (20.0)
Citrobacter freundii	3 (12.0)
Enterobacter cloacae	2 (8.0)
Pseudomonas aeruginosa	1 (4.0)
Citrobacter werkmanii	1 (4.0)
Proteus mirabilis	1 (4.0)
Klebsiella oxytoca	1 (4.0)
Gram pozitive coccus	14 (56.0)
Enterococcus faecalis	9 (36.0)
Enterococcus faecium	3 (12.0)
Enterococcus casseliflavus	1 (4.0)
Enterococcus hirae	1 (4.0)
Enterococcus avium	1 (4.0)
Gram positive	1 (4.0)
Corynebacterium striatum	1 (4.0)
No culture	45 (64.3)
Change in antibiotic treatment	14 (20.0)
Ampicillin sulbactam	4 (5.7)
Imipenem	4 (5.7)
Tigecycline	3 (4.3)
Sulperazon	1 (1.4)
Piperacillin tazobactam	1 (1.4)
Ciprofloxacin	1 (1.4)

Bile culture was sent from 25 patients and the most frequently isolated bacteria were Enterococcus faecalis (9/25, 36.0%) and Escherichia coli (5/25, 20.0%). The most common used antibiotic treatment was ceftriaxone (57/70, 81.4%) (Table 2). Ceftriaxon was used to at 97% (32/33) of TG 18 grade I AC patients, 65.6% (21/32) of TG 18 grade II AC patients, and 80% (4/5) of TG 18 grade III AC patients. Antibiotic treatment was changed in 14 patients according to clinical response and culture results. The most changed antibiotic was ceftriaxone (13/14, 92.9%). Complications were developed in 10 (14.3%) patients during PC treatment including: pulmonary edema in two patients, atelectasis in two patients, cerebrovascular disease in one patient, and pneumonia in one patient. Catheter-related complications were developed in four patients. Biliary fistula was developed in two patients after the removal of the PC catheter. One patients with persistent bile leakage required ERCP, whereas the other recovered by medical treatment. Emergent cholecystectomy was performed in two patients who developed PC catheter occlusion. AC recurrence developed in seven patients (10.0%) and the median AC recurrence duration was 21 (8-37) days. Six patients who PC catheter were received antibiotic treatment, and one patient who no-PC catheter underwent emergent cholecystectomy. The mean length of hospital stay was mean 11.9 (2–42) days. Mortality was observed in 12 cases (17.1%), including 11 patients who underwent PC and one patient who underwent cholecystectomy following PC. Surgical treatment was performed in total 31 patients after PC, of which three emergent and 28 elective surgery. Surgical treatment could not be performed in 28 patients due to their comorbidities and patient preference after PC. Surgery could not be performed in 11 patients who developed mortality during PC treatment.

Table 3. Factors affecting the success of percutaneous cholecystostomy treatment

	PC treatment		Univariate analysis				Multivariate analysis			
	Successful (n=60, %)	Failure (n=10, %)	OR	C.I. %95 Lower	C.I. %95 Upper	p	OR	C.I. %95 Lower	C.I. %95 Upper	p
Age (years)	74 (40-94)	72 (62-81)				0.13				
Gender						1.00				
Female	12 (85.7)	2 (14.3)								
Male	48 (85.7)	8 (14.3)								
ASA score						0.005				0.03
≥IV	20 (71.4)	8 (28.6)	8.000	1.552	41.234		2.154	1.016	4.491	
IV	40 (95.2)	2 (4.8)								
Comorbidity (Yes)										0.07
Hypertension	36 (86.7)	7 (13.3)				0.55				
CHF	22 (78.6)	6 (21.4)				0.16				
DM type 2	23 (85.2)	4 (14.8)				0.92				
COPD	12 (70.6)	5 (29.4)				0.04				
CAD	12 (75.0)	4 (25.0)	4.000	0.995	16.086	0.16	1.774	0.970	3.343	
CKF	9 (75.0)	3 (25.0)				0.24				
CVA	9 (90.0)	1 (10.0)				0.68				
AKF	5 (83.3)	1 (16.7)				0.86				
Malignancy	5 (100.0)	0 (0)				0.34				
Alzheimer disease	3 (75.0)	1 (25.0)				0.53				

Elevated LFT (Yes)										
ALT	18 (78.3)	5 (21.7)				0.24				
AST	21 (77.8)	6 (22.2)				0.16				
ALP	25 (86.2)	4 (13.8)				0.79				
GGT	30 (78.9)	8 (21.1)				0.17				
D Bil	36 (81.8)	8 (19.2)				0.30				
T Bil	18 (72.0)	7 (28.0)	5.185	1.201	22.382	0.02				
CRP (mg/L)	21.5 (0-37.4)	20.8 (6.3-35.2)				0.20				
Leukocyte (×10³/µL)	14.0 (4.1-31.4)	16.8 (14.4-19.2)				0.91				
Tokyo Guidelines 18 (Yes)						0.86				
Grade I	29 (87.9)	4 (12.1)								
Grade II	27 (84.4)	5 (15.6)								
Grade III	4 (80.0)	1 (20.0)								
Duration of MT (day)	2 (1-13)	2 (1-2)				0.24				
PC catheter diameter						0.24				
6	6 (100.0)	0 (0)								
8	44 (89.8)	5 (10.2)								
10	9 (75.0)	3 (25.0)								
Duration of PC (day)						<0.001				0.005
≥14	38 (95.0)	2 (5.0)								
14	12 ((60.0)	8 (40.0)	16.000	2.931	87.354		2.615	1.000	6.834	
LOS (day)	11.3±5.9, 9 (3-27)	9.5±2.1, 10 (8-11)				0.97				

PC: Percutaneous cholecystostomy, OR: Odds ratio, C.I.: Confidence interval, ASA: American Society of Anesthesiologists, CHF: Congestive heart failure, DM: Diabetes Mellitus type 2, COPD: Chronic obstructive pulmonary disease, CAD: Coronary artery disease, CKF: Chronic kidney failure, CVA: Cerebrovascular accident, AKF: Acute kidney failure, Malignancy: Chronic myeloid leukemia, Lymphoma, Rectum cancer, Gastric cancer, Kaposi's sarcoma, LFT: Liver function tests, ALT: Alanine transaminase, AST: Aspartate transaminase, ALP: Alkaline phosphatase, GGT: Gamma-glutamyl transferase, D Bil: Direct bilirubin, T Bil: Total bilirubin, CRP: C-reactive protein, MT: Medical treatment, LOS: Length of hospital stay

In the one-way analysis, an ASA ≥ IV score (28.6% vs. 4.8%, OR: 8,000; p = 0.005), COPD (50.0% vs. 29.4%, OR: 4,000; p = 0.04), elevated total bilirubin (70.0% vs. 28.0%, OR: 5.185; p = 0.02), and duration of PC <14 days (40.0% vs. 5.0%, OR: 16.000; p < 0.001) were found to be risk factors reducing the success of PC. In the logistic regression analysis, an ASA ≥ IV score (OR: 2.154, p = 0.03) and duration of PC < 14 days (OR: 2.615, p = 0.005) were found to be independent variables reducing the success of PC (Table 3). Although COPD reduced the success of PC, it was not found as an independent variable (OR: 1.774, p = 0.07).

DISCUSSION

In our study, the clinical success rate of PC was 85.7%. PC provided definitive treatment in 40.0% of patients at a median eight month (1-119) follow-up. The recurrence rate of PC was 10.0%, and mortality rate was 17.1%. The median length of hospital stay was 10 (2-42) days. International guidelines have recommended PC as an alternative to surgery in high-risk patients with AC (8,9). A systematic review reported that PC provided definitive treatment without the need for cholecystectomy in more than half of patients with AC (7). Even, Chung et al reported that PC treatment can be used in patients who are not eligible for emergent cholecystectomy in the presence of severe sepsis (17,18). Ozyer et al reported that the success of PC as 87.2% at the median eight month follow-up (15). In the systematic review by Maccini et al., the recurrence rate of disease was reported to be 12.1% in the median 16 months follow-up (19). However, there are also studies reporting a disease recurrence rate of 49% over a median period of 12 months and 4.1% over a median period of 60 months (20,21). Macchini et al. reported mortality rates to be 15.8% (range, 1.9–80.2) in patients who applied PC (19). The high mortality rate among patients applying PC was attributed to advanced age and a higher rate of comorbidities in these patients (22). The length of hospital stay varies between 3 and 17.5 days after PC (7).

Many factors have been reported that affect the success and its recurrence of PC who high-risk AC patients. Presence of acute myocardial infarction and elevated serum alkaline phosphatase levels at the time of diagnosis, alcohol use, uncomplicated Diabetes Mellitus, heart failure, depression, and presence of metastatic cancer, calculous AC and purulent gallbladder were found to be risk factors for AC recurrence (23-25). In our study, COPD, elevation of total bilirubin, an ASA ≥ IV score, and duration of PC <14 days were found to be risk factors reducing the success of PC. Among of these, an ASA ≥ IV score and duration of PC <14 days were found to be independent variables reducing the success of PC. In a previous study, Smith et al. reported that patients undergoing PC between 1989 and 1998 had ASA III and IV scores, this rate dropped to 82% between 1998 and 2009 (26). Additionally, Tolan et al. showed that PC could be used as a definitive treatment in 57.5% of AC patients who high ASA scores (27).

Jang et al. reported that PC is an effective method in high-risk patients with AC, however; ASA score was not significant in AC recurrence (28). In our study, patients treated with PC according to ASA scores IV, III, and II were 40.0%, 20.0%, and 40.0%; respectively. The rate of failure in PC was higher in patients with an ASA ≥ IV score than in those with an ASA < IV score (28.6% vs. 4.8%, p = 0.005), and an ASA ≥ IV score was found to be an independent variable for failure PC (OR: 2.1, p = 0.03). Explanations for the higher rate of treatment failure in patients with an ASA ≥ IV score were advanced age (median 77 vs. 72) and a higher rate of comorbidities. Additionally, ASA ≥ IV score was not associated with AC recurrence (%7.1 vs %11.4, p=0.70).

The PC catheter usually remove in second week after in the transhepatic approach and in third week after in the transperitoneal approach (29,30). However, the optimal duration of PC in patients with AC is controversial. Park et al. reported that the PC drainage duration should be at least six weeks, while Hasbahceci et al. reported that remaining PC catheter in place until the surgery in suitable patients for surgery reduced AC recurrence (14,31). In a systematic review examining the effect of catheter removal time on treatment outcome, it was reported that catheter removal time varied between 2–193 days, and there was no evidence that the duration of PC drainage could affect outcomes (19). In our study, there was no consensus on the time of PC catheter removal. The mean removal time PC catheter was 32 days (2-98). PC catheters were removed in 39 (55.8%) patients according to resolution of symptoms, CRP level and WBC count and also removed in 19 (27.1%) patients during cholecystectomy. Removal of the PC catheter within 14 days was found to be an independent variable for the failure PC treatment (OR: 2.6, p = 0.005).

This study has some limitations. The study design was retrospective, and it is possible that medical records were not complete. The sample size was small, especially TG 18 grade III AC patients. The decision to perform PC was made by the attending physician at the time of admission, and each physician used different criteria based on their experiences and personal preferences. All these factors may have affected the clinical results of this study.

CONCLUSION

PC can be used safely in high-risk AC patients with high clinical success and low recurrence rates. To achieve successful rate of PC, the PC catheter should not be removed earlier than 14 days. An ASA score ≥ IV patients should be followed closely and surgical treatment should be considered when appropriate conditions are provided.

Competing interests: The authors declare that they have no competing interest.

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Ethical approval: This study was approved by the Institutional Ethics Committee (Karadeniz Technical University (decision number: 2018/185)) .

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