

Percutaneous cholecystostomy for management of acute cholecystitis in severely ill patients

Percutaneous cholecystostomy in acute cholecystitis

Oğuzhan Özdemir¹, Volkan Kızılgöz², Türkhun Çetin², Doğan Gönüllü³

¹Department of Radiology, VM Medical Park Ankara Hospital, Ankara

²Department of Radiology, Kafkas University, Faculty of Medicine, Kars

³Department of General Surgery, Kafkas University, Faculty of Medicine, Kars, Turkey

Abstract

Aim: In this study, we aimed to determine the therapeutic efficacy of percutaneous cholecystostomy (PC) in critically ill patients with an APACHE II score greater than or equal to 12 in the management of acute cholecystitis (AC) compared to conservative treatment.

Material and Methods: Clinical data from January 2007 to June 2020 of 132 and 125 patients managed by PC and conservative treatment, respectively, were retrospectively analyzed. Medical records of patient demographics, comorbidities, indications for PC catheter placement, complications, alterations in laboratory parameters (white blood cell (WBC) count, C-reactive protein (CRP) value) and APACHE II scores, and clinical outcomes during follow-up were retrieved from our hospital database for this case-control study.

Results: After PC, a statistically significant decrease in WBC counts, CRP values and APACHE II scores was found in the study group compared to the control group ($p < 0.022$). Additionally, the admission to follow-up ratio of WBC counts, CRP values and APACHE II scores was significantly higher in the study group than in the control group ($p < 0.001$). Following PC, WBC counts, CRP values and APACHE II scores decreased significantly over time ($p < 0.001$). After the PC procedure, catheter indwelling time ranged from 1 to 45 days. Except for one patient who died within a few hours following intervention, no major complications related to PC were observed. Out of 132 patients, 29 minor complications were noted.

Discussion: In critically ill, high-risk patients, PC compared to conservative treatment was found to be a safe and efficient salvage therapy for the management of AC.

Keywords

Acute cholecystitis; Cholecystostomy; Interventional radiology; Ultrasonography; APACHE II; Intensive care units

DOI: 10.4328/ACAM.20399 Received: 2020-11-12 Accepted: 2020-12-11 Published Online: 2020-12-21 Printed: 2021-06-15 Ann Clin Anal Med 2021;12(Suppl 2): S142-148

Corresponding Author: Volkan Kızılgöz, Kafkas University, Faculty of Medicine, Department of Radiology, Kars, Turkey.

E-mail: volkankizilgoz@gmail.com P: +90 5057994013

Corresponding Author ORCID ID: <https://orcid.org/0000-0003-3450-711X>

Introduction

Acute cholecystitis (AC) is one of the most common emergency applications to general surgery services. Treatment options for AC include open or laparoscopic cholecystectomy (LC). It has been reported that emergency cholecystectomy, delayed or interval LC, following conservative management with antibiotic therapy and supportive care for AC, is associated with high morbidity and mortality rates in critically ill patients with significant comorbidities; in addition, they are considered potentially high-risk for surgery [1]. These patients are also prone to the progression of disease to empyema, gangrene, perforation, and abscess formation with conservative treatment [1]. It has also been reported that patients in intensive care units (ICUs) are especially prone to AC, and their clinical outcome is generally sepsis. AC has high morbidity and mortality in these patients, largely because of delays in diagnosis [2].

In patients with AC, percutaneous cholecystostomy (PC) has been promoted as an alternative to surgery in many studies; however, no consensus has been reached yet on the need for delayed or interval cholecystectomy [3]. PC was performed only when an extensive clinical, laboratory and radiological search did not reveal other sources for sepsis outside the gallbladder. An ultrasound (US) guided PC for therapeutic purposes was first reported in 1979 [4]. The first report of PC for the management of AC was given in 1980 [5]. PC has been used as a relatively safe and efficient intervention for the treatment of AC in high-risk, critically ill patients with serious comorbidities and in elderly patients, circumventing general anesthesia necessary for laparoscopic or open cholecystectomy [1].

The present retrospective study aimed to assess the safety and therapeutic efficacy of PC for AC in critically ill high-risk patients with comorbid diseases compared with conservative management. To our knowledge, this study involved the largest study population, most of whom were critically ill elderly already hospitalized in ICUs and services with an Acute Physiology and Chronic Health Evaluation II (APACHE II) score greater than or equal to 12.

Material and Methods

Patient population

Clinical records from January 2007 to June 2020 of surgically high-risk patients with clinical, laboratory and radiological findings of AC and an APACHE II score greater than or equal to 12 were analyzed retrospectively. Patients were randomly assigned into two groups: (1) the study group ($n = 132$) who underwent PC, and (2) the control group ($n = 125$) who was managed with conservative treatment. All patients were critically ill, had significant comorbid disease with varying degrees of septic findings, and were considered high-risk patients for surgery. These patients were referred to the interventional radiology department for PC.

The majority of the patients were being followed in ICUs and services because of other comorbid diseases and a small number of them were ambulatory. All ambulatory patients were hospitalized following AC diagnosis. ICU patients had unexplained sepsis and, after a complete clinical, laboratory and radiological evaluation, exhibited no source of sepsis outside the gallbladder. After a collaborative discussion between the

surgeon, the intensive care specialist and the interventional radiologist, the final decision by consensus was reached regarding the treatment options (i.e., PC or conservative treatment). When extensive clinical, laboratory and radiological search did not identify any other source of sepsis outside the gallbladder, PC was performed. Additionally, patients whose PC procedure technically failed were included in the control group receiving only conservative treatment.

Patients who were pregnant or under the age of 18, and patients without comorbid disease and an APACHE II score under 12, were excluded from the study. Also patients whose at least one-month follow-up clinical data were not available in the archives were excluded.

When we consider the patient distribution with regard to the comorbidities, in the study group, there were 107 patients with multisystem disease, 103 patients with debilitation, 89 patients with cardiovascular disease, 74 patients with pulmonary disease, 71 patients with malignancy, 41 patients with neurological disease, 39 patients with diabetes mellitus, 34 patients with chronic renal disease, 21 patients with chronic liver disease, 16 patients with hematologic disease, 13 patients with deep vein thrombosis, 9 patients with immunosuppression, 6 patients with trauma, and 5 patients with morbid obesity. In the control group, there were 93 patients with multisystem disease, 96 patients with debilitation, 77 patients with cardiovascular disease, 69 patients with pulmonary disease, 65 patients with malignancy, 33 patients with neurological disease, 28 patients with diabetes mellitus, 30 patients with chronic renal disease, 13 patients with chronic liver disease, 11 patients with hematologic disease, 8 patients with deep vein thrombosis, 4 patients with immunosuppression, 3 patients with trauma and 2 patients with morbid obesity.

There were no patients with grade I score according to the Tokyo guidelines 2018 (TG18) for the severity of acute cholecystitis, however, there were 72 patients with grade II, 60 patients with grade III score in the study group and 67 patients with grade II, 58 patients with grade III score in the control group according to the TG18 classification.

Considering the gallbladder ultrasonography findings of patients, wall thickening was reported in 118 patients, pericholecystic fluid in 103 patients, hydrops in 89 of patients, sludge in 79 patients and calculi in 67 patients. In the control group, 109 patients with wall thickening, 88 patients with pericholecystic fluid, 80 patients with the hydropic gallbladder, 72 patients with sludge in the gallbladder lumen and 59 patients with calculi were observed during the ultrasonographic examination.

Cholangiogram performed for 117 (88,6%) patients revealed a stone in the gallbladder in 64 (54,7%) patients, a stone in the cystic duct in 26 (22,2%) patients, patent cystic duct in 70 (59,8%) patients, obstructed cystic duct in 47 (40,1%) patients, choledocolithiasis in 11 (9,4%) patients.

The institutional review board approved this study, and the ethics committee waived the need for informed consent from each patient due to the retrospective nature of the investigation.

Diagnosis of AC and follow-up

Ultrasonography criteria for AC were as follows: (1) gallbladder wall thickness greater than three mm, (2) hydrops of the

gallbladder, (3) US Murphy's sign, (4) stone or sludge formation, (5) the presence of pericholecystic fluid, and (6) positive US Murphy's sign. For AC diagnosis, at least two criteria for each patient were needed. Cholecystitis severity grading was performed according to the Tokyo Guidelines criteria of 2018 (TG18) [6].

All patients had significant comorbidities and were considered high-risk for surgery. The APACHE II clinical scoring system was applied to each patient's clinical status both on admission and at follow-up. Those with a score greater than or equal to 12 were considered surgically high-risk patients [7].

Laboratory tests used for diagnosis and follow-up were white blood cell (WBC) counts, C-reactive protein (CRP) values, and total bilirubin, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels. The results of admission and follow-up WBC counts, CRP levels and APACHE II scores were recorded.

WBC count, CRP value and APACHE II score obtained at admission, twenty-fourth hour and forty-eighth hour were represented by WBC 1, CRP 1, and APACHE 1; WBC 2, CRP 2, and APACHE 2; and WBC 3, CRP 3, and APACHE 3, respectively.

Management and PC technique

All patients had already been started on broad-spectrum antibiotics and metronidazole when referred to the department of interventional radiology. All PC interventions were performed by one experienced interventional radiologist. All PC procedures were performed at the bedside in the ICU patients and some service patients. PC was performed via transperitoneal ($n = 98$) and transhepatic ($n = 34$) routes under US guidance. Pigtail drainage catheters of either 8 Fr ($n = 95$) or 10 Fr ($n = 37$) were routinely used. Catheters were placed using the Seldinger technique. After insertion of the needle, a bile sample was obtained and sent for culture. After an 18G Chiba needle puncture to the fundus of the gallbladder under US guidance, a 0.035 guidewire with a three mm j-tip was inserted, then the tract was dilated with 7–9 Fr dilators, followed by catheter placement. When possible, after puncture guidewire insertion, tract dilatation and catheter placement were performed under fluoroscopy. However, in a significant number of patients, fluoroscopy was not possible, mostly in ICU patients; for them, the entire procedure was carried out only under US guidance. When the catheter loop was visualized either ultrasonographically or fluoroscopically in the gallbladder lumen (Figure 1), PC was considered technically successful. The catheter was anchored to the skin with stitches, placed on gravity drainage and irrigated daily with 10 ml of sterile saline to prevent occlusion. Whenever possible (after resolution of septic findings), cholangiography was performed in the next days. Following catheter placement, drainage was allowed for at least two to three weeks for tract maturation, depending on the route of catheter insertion (i.e. transhepatic or transperitoneal).

Statistical analysis

All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS 13.0 Statistical Software, SPSS Inc., Chicago, IL, USA) and the MedCalc package MedCalc Statistical Software version 16.8 (MedCalc Software bvba, Ostend, Belgium). The means and ranges for age, CRP levels, WBC counts, WBC ratios 1-2, CRP ratios 1-2 and APACHE II

scores were calculated for the study and control groups. To show deviation from the normal distribution, the Kolmogorov-Smirnov test was used. Within each treatment period, changes in serum CRP levels, WBC counts and APACHE II scores were assessed using the Friedman test followed by post-hoc tests. The changes in WBC and CRP ratio 1-2 in the ICU, services, and ambulatory patients in the study and control groups were compared with the Mann-Whitney U test. A p-value less than 0.05 was considered statistically significant.

Results

All patients were high-risk surgical patients with findings of AC and APACHE II scores greater than or equal to 12. There was no statistically significant difference between the patient and control groups for TG18 scores ($p = 0.512$).

This study included only 132 technically successful PC patients and compared them to those who received only conservative treatment. Among the 132 PC patients, 62 (46.9%) were male and 70 (53%) were female. Among the 125 controls, 53 (42.4%) were male and 69 (57.6%) were female. The age range for the study and control groups was 47–102 (mean: 74.8 ± 10.2) and 50–98 (mean: 73.7 ± 10.5), respectively. There was no significant difference in the ages between the patient and the control group ($p = 0.052$).

Among the study and control groups, 121 (91.6%) [64 (48.4%) in ICU and 57 (43.1%) in-service] and 111 (88.8%) [75 (60%) in ICU, 36 (28.8%) in-service] were already hospitalized, while 11 (8.3%), and 14 (11.2%) were ambulatory, respectively. All ambulatory patients were hospitalized after the intervention. Patients in the study and control groups had symptoms and laboratory findings of AC, ranging from one to 13 days (mean: $4.5 \text{ days} \pm 2.3$) and one to 11 days (mean: 4.3 ± 2.5), respectively. For the study and control groups, the mean duration of findings of AC was 4.5 days (range: 1–13 days ± 2.3) and 4.3 days (range: 1–11 days ± 2.5), respectively. The overall mean catheter indwelling time after PC ranged from one to 75 days (mean: $41.7 \text{ days} \pm 15.4$), while it ranged from one to 75 days (mean: $46.1 \text{ days} \pm 16.6$) for ICU patients ($p = 0.051$). In regards to the catheter insertion approach, the catheter indwelling time ranged from one to 73 days (mean: $44.1 \text{ days} \pm 16.2$) and six to 75 days (mean: $45 \text{ days} \pm 16.9$) for transperitoneal and transhepatic routes, respectively ($p = 0.053$). Due to choledocholithiasis during follow-up, 11 patients in the study group and six patients in the control group underwent endoscopic retrograde cholangiopancreatography (ERCP). LC was performed in 20 of the 132 patients in the study group, over a period of two to eight months (mean $4.6 \text{ months} \pm 1.6$). On the other hand, 16 of 125 patients in the control group underwent LC within three to nine months (mean: $5.6 \text{ months} \pm 1.6$).

In addition to PC, all patients received antibiotics. The mean interval from diagnosis of AC to PC was 2.3 days. One patient died due to massive intra-abdominal bleeding within a few hours after the PC procedure. In the rest ($n = 131$), no attributable mortality or major complications were observed. Except for temporary and moderate pain, no significant periprocedural complication was observed in those patients. Minor bleeding was noted in nine patients (6%). Thirteen patients (9.8%) developed simple skin infections at the catheter site.

Table 1. The distribution of WBC ratio, CRP ratio and APACHE II ratio values with regard to ICU, service and ambulatory patients

	Total value (mean ± SD)	Study and control groups		p value
		Study group (mean ± SD)	Control group (mean ± SD)	
ICU patients				
WBC ratio 1	17.1 ± 15.6	20.4 ± 12.9	14.4 ± 17.1	0.026
WBC ratio 2	36.3 ± 24.7	45.2 ± 19.8	28.7 ± 28.5	0.004
CRP ratio 1	23.6 ± 20.6	29.9 ± 18.3	18.5 ± 23.1	0.004
CRP ratio 2	46.2 ± 34.5	58.7 ± 28.4	35.6 ± 40.9	0.006
APACHE II ratio 1	10.3 ± 9.9	16.3 ± 9.4	5.2 ± 7.3	<0.001
APACHE II ratio 2	18.6 ± 13.5	25.1 ± 11.9	13.1 ± 12.2	<0.001
Service patients				
WBC ratio 1	21.2 ± 15.7	24.4 ± 14.5	16.2 ± 16.4	0.012
WBC ratio 2	41.7 ± 20.0	47.1 ± 14.3	33.1 ± 24.5	0.007
CRP ratio 1	30.4 ± 18.2	34.0 ± 13.9	24.5 ± 22.4	0.073
CRP ratio 2	56.7 ± 24.3	62.4 ± 14.1	47.6 ± 33.1	0.163
APACHE II ratio 1	11.4 ± 8.1	15.4 ± 6.2	5.0 ± 6.5	<0.001
APACHE II ratio 2	23.2 ± 10.8	28.1 ± 7.9	15.5 ± 10.4	<0.001
Ambulatory patients				
WBC ratio 1	27.4 ± 12.9	29.0 ± 12.4	26.1 ± 13.5	0.647
WBC ratio 2	46.9 ± 10.8	48.0 ± 6.3	46.1 ± 13.6	0.893
CRP ratio 1	35.6 ± 16.6	37.8 ± 15.4	33.8 ± 17.8	0.647
CRP ratio 2	58.5 ± 15.5	62.0 ± 9.3	55.8 ± 19.0	0.501
APACHE II ratio 1	11.4 ± 8.1	18.3 ± 4.7	8.8 ± 4.9	<0.001
APACHE II ratio 2	23.2 ± 10.8	28.8 ± 6.8	18.2 ± 7.3	<0.001

SD: standard deviation, Study group: patients who underwent percutaneous cholecystostomy
 Control group: patients who received conservative treatment, ICU: intensive care unit
 WBC 1: white blood cell count on admission, WBC 2: white blood cell count after 24 hours
 WBC 3: white blood cell count after 48 hours, CRP 1: serum C-reactive protein level on admission
 CRP 2: serum C-reactive protein level after 24 hours, CRP 3: serum C-reactive protein level after 48 hours
 WBC ratio 1: [(WBC 1 – WBC 2) / WBC 1] × 100, WBC ratio 2: [(WBC 1 – WBC 3) / WBC 1] × 100
 CRP ratio 1: [(CRP 1 – CRP 2) / CRP 1] × 100, CRP ratio 2: [(CRP 1 – CRP 3) / CRP 1] × 100
 APACHE II-1: acute physiology and chronic health evaluation II score on admission
 APACHE II-2: acute physiology and chronic health evaluation II score after 24 hours
 APACHE II-3: acute physiology and chronic health evaluation II score after 48 hours
 APACHE II ratio 1: [(APACHE II-1 – APACHE II-2) / APACHE II-1] × 100
 APACHE II ratio 2: [(APACHE II-1 – APACHE II-3) / APACHE II-1] × 100

Table 2. The two days results of patients with regards to APACHE II scores.

Time	Groups	APACHE II scores		
		<12	12-15	>15
First admission	Study group	-	107	24
	Control group	-	98	27
After 24 hrs	Study group	73	46	12
	Control group	21	90	14
After 48 hrs	Study group	114	6	11
	Control group	88	24	13

Study group: patients who underwent percutaneous cholecystostomy; Control group: patients who received conservative treatment; APACHE II: acute physiology and chronic health evaluation II score; hrs: hours

Table 3. The one-month follow-up and patient outcomes.

	Day 1		Day 2		Day 3		Week 2		Month 1	
	Study	Control	Study	Control	Study	Control	Study	Control	Study	Control
ICU	64	75	62	77	59	79	27	46	13	23
Service	57	36	68	48	71	46	15	32	8	15
Ambulatory	11	14	-	-	-	-	86	41	101	74
Ex	-	-	1	-	-	2	2	4	6	7
Total	132	125	130	125	130	123	128	119	122	112

ICU: intensive care unit.

In seven patients (5.3%), biliary peritonitis, which resolved within a few days, was observed. Catheter dislodgement was noted in 13 patients (9.8%) during the follow-up. In nine of them, there was no need for recatheterization because the septic findings had already resolved. In the remaining four, recatheterization was performed because of the ongoing septic findings. In 97 (73.4%) patients, bile aspirated at the time of catheter placement was culture positive. Escherichia coli was the most frequently cultured pathogen (53.6%). After PC, cholangiography could be performed in a total of 117 patients (88.6%) within over a period of one to six days (mean: 3.7 days ± 1.5).

On admission, there was no significant difference between WBC counts, CRP values and APACHE II scores in the study and control groups (p > 0.413). Following PC, WBC counts, CRP values and APACHE II scores decreased significantly over time (p < 0.001), as shown in Figure 3. Moreover, after PC, a statistically significant decrease was found in WBC-2, WBC-3 counts and CRP-2, CRP-3 values of the study group compared to the control group (p < 0.022). Additionally, the WBC ratio 1-2 and the CRP ratio 1-2 were significantly higher in the study group than the control group (p < 0.001; Table 1).

Table 2 shows the changes in APACHE II scores at admission and 48-hour follow-up for both groups. Table 3 and Figure 3 show a one-month follow-up for both groups. One patient died due to massive bleeding within a few hours after PC. In the control group, 21 patients (16.8%) developed serious complications (nine perforations, three empyemas, three gangrenous cholecystitis, and six abscesses) related to AC. Ten of 13 total deaths in the control group were due to septic shock related to these complications, while the rest were due to underlying comorbid diseases. None of the patients in the study group faced complications related to AC. During this period, eight patients in the study group died from severe comorbid diseases not related to the PC procedure. At the end of the one-month follow-up period, 102 patients (77.7%) of the study group and 74 patients (59.2%) of the control group were discharged from the hospital.

When classifying the patients according to the place of hospitalization, (1) ICU patients showed a significant increase in WBC ratio 1-2 and CRP ratio 1-2 (p < 0.026), (2) service patients showed a significant increase in WBC ratio 1-2 (p < 0.012) and an insignificant difference in CRP ratio 1-2 (p > 0.073), and (3) those who were ambulatory at admission showed an insignificant difference (p > 0.501) when comparing the the study and control groups, respectively. In all three categories, the APACHE ratio 1-2 significantly increased in the study group compared to the control group (p < 0.001).

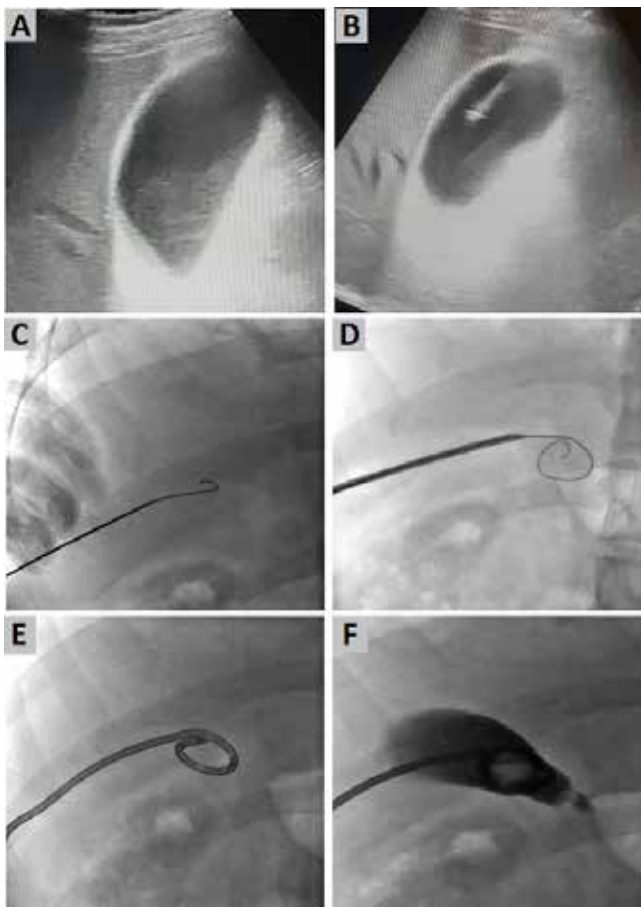


Figure 1. Percutaneous cholecystostomy of a 64-year-old male patient with findings of acute cholecystitis and an APACHE II score of 16. (A) Diffuse wall thickening and sludge in the lumen of the gallbladder was observed in the ultrasonographic examination. (B) An 18G Chiba needle was punctured to the gallbladder fundus by transperitoneal route under ultrasonography guidance. (C, D) The guidewire was introduced and (E) the catheter was placed under fluoroscopy. (F) The control image confirms that the catheter was placed exactly in the gallbladder lumen. APACHE II: acute physiology and chronic health evaluation II score.

In terms of analyzing the 13-year accessible recorded data, the mean time frame that was possible for obtaining data ranged from one to 12 months (mean: 4.5 months \pm 2.1) and one to eleven months (mean: 4.4 months \pm 2.3), respectively, for the study and control groups. In the study group, LC was performed in 20 of the 132 patients in the period from two to eight months (mean 4.6 months \pm 1.6). On the other hand, in the control group, 16 of 125 patients underwent LC between three and nine months (mean: 5.6 months \pm 1.6). All patients who underwent LC had gallbladder stones. Recurrent cholecystitis rates were 6.8% (n = 9) and 16% (n = 20) for the study and control groups, respectively. Among these patients, admission calculous AC rates of 88.8% (n = 8) and 85% (n = 17) were noted in these respective groups. Six of them underwent a second PC intervention. The overall long-term mortality rates during this time frame until study conclusion were 26.5% (n = 35) and 30.4% (n = 38) for the study and control groups, respectively.

Discussion

This is the largest review, to our knowledge, analyzing the efficacy and safety of PC compared to conservative management of AC in patients with APACHE II scores greater than or equal to 12. In addition, this study seems to be unique in having the largest ICU population. It has been reported that ICU patients have an increased risk of AC and are prone to high morbidity and mortality because of diagnostic difficulties [8]. In recent years, interval cholecystectomy has come to the fore as a preferable option after medical treatment [9] in high-risk patients with AC. However, previous reports have shown that some comorbid patients with AC who were managed conservatively may be at risk for complications such as empyema, gangrene, and perforation [8], as shown by our conservative patient group (n= 21). The Tokyo Guidelines 2018 (TG18) recommend PC as an alternative for such patients [9]. Hatzidakis et al. [10] carried out the sole randomized study comparing PC with conservative management in high-risk patients (APACHE II score \geq 12) with AC. The authors stated that in the early follow-up period, PC did not reduce mortality in high-risk patients over conservative management in AC (18% vs 13%).

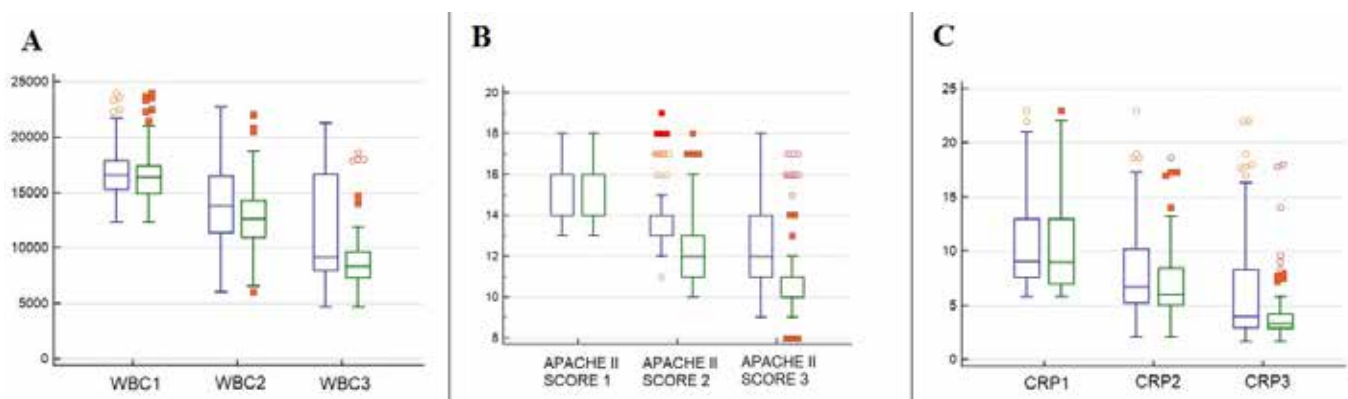


Figure 2. Graphs show the change of (A) WBC mean, (B) CRP mean, and (C) APACHE II score mean in the first 48-hour period following percutaneous cholecystostomy. APACHE II: acute physiology and chronic health evaluation II score; CRP: serum C-reactive protein; WBC: white blood cell.

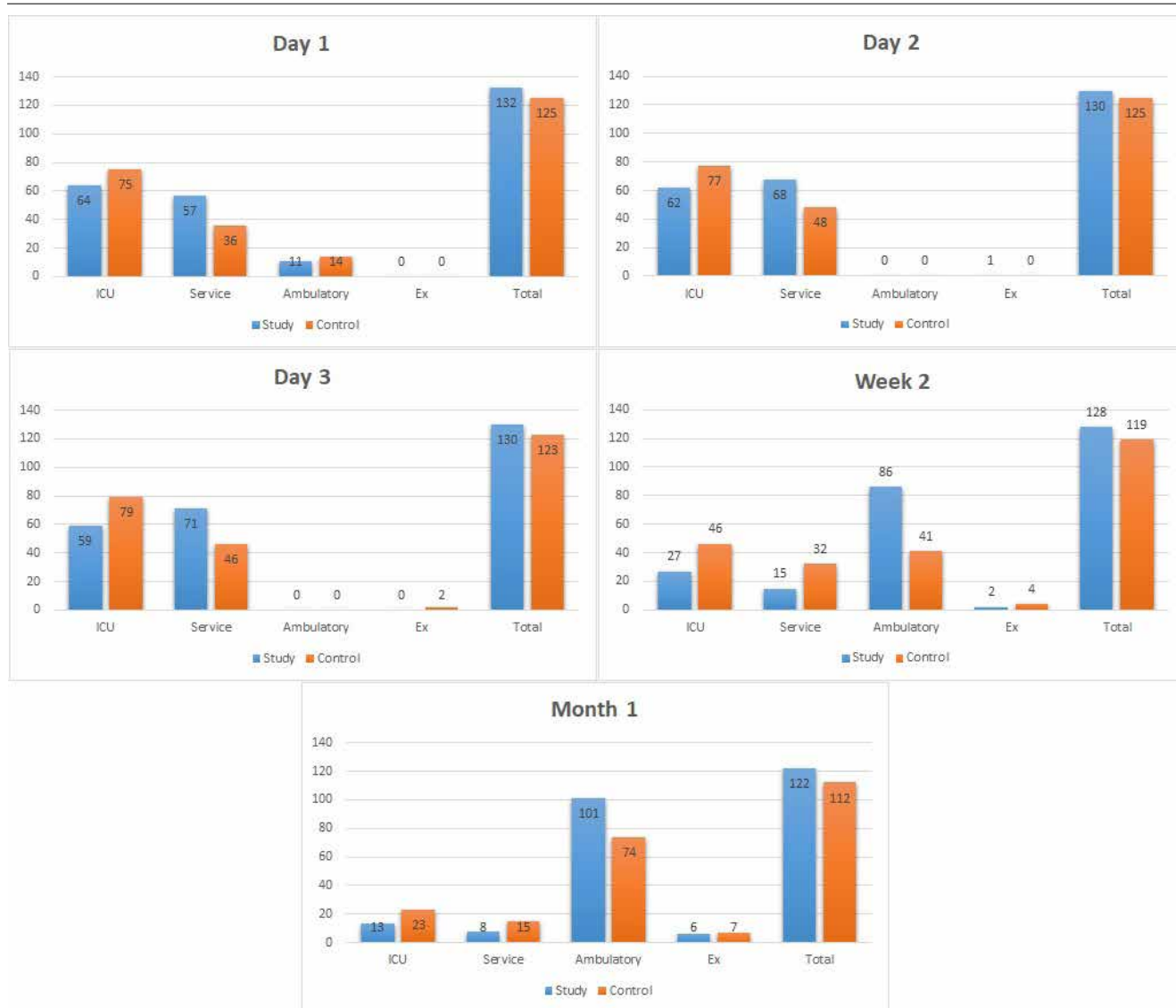


Figure 3. The one-month follow-up and patient outcomes of the study and control groups. Note the remarkable reduction in, and clinical progress of, intensive care unit patients in the study group.

However, our overall mortality rates for the study and control groups at one-month early follow-up were 6.8% (n = 9) and 10.4% (n = 13), respectively, showing PC as an efficient intervention for managing AC in high-risk critically ill patients. The transhepatic approach is the most commonly used access in PC [11]. Many reports suggest that this method is safer than a transperitoneal approach, with a lower risk of bowel injury and bile peritonitis, but with higher rates of complications such as hepatic bleeding and hemobiliary fistula [11–15]. In our study, in contrast to the literature, the access route was mostly transperitoneal. Comparable to some other studies [16], we did not face any major complications related to the transperitoneal approach. The optimal duration of catheter indwelling times is still being debated in the literature. Moreover, it has been reported that catheter removal decisions are generally based on subjective clinical evidence rather than hard evidence [1]. Okan et al. [8] suggested that before catheter removal, the drainage tract should be mature enough to prevent bile leakage, the patient should be asymptomatic, and cystic duct patency should be confirmed by cholangiography. One report stated that for mature tract development, two and three weeks are required for transhepatic and transperitoneal approach,

respectively [17]. In the present study, cholangiography could be performed in 88.6% of patients, after PC, with a mean of 3.7 days. However, our catheter removal decision was mainly based on clinical status, as well as a minimum two- and three-week catheterization period, for transhepatic and transperitoneal approaches, respectively, and a symptom-free period of three days after catheter clamping, in consideration of tract maturation. In the literature, it was stated that the ideal catheter maintenance time is when tract consolidation is revealed on tractography [17]. In the largest series, by Bundy et al. [11], the mean indwelling catheter time was reported to be 89 days, far longer than our study. They concluded that the long time might be a reflection of the increased frequency of cholecystoscopy with stone removal performed at their institution. Let us remind that none of our patients underwent such an intervention at our institutions. In the present study, with regard to the catheter insertion approach, a mean of 44.1 and 45 days of catheter stay was found for the transperitoneal and transhepatic routes, respectively. These results were found to be statistically insignificant (p >0.05). Hatjidakis et al. reported a longer catheter stay in the transperitoneal compared to the transhepatic route [17]. For comparison, we found that

the catheter stay time for the transhepatic route was slightly longer than for the transperitoneal route.

In the present study, 89.3% of the study and 70.4% of the control group showed clinical improvement with a mean of three days. In contrast, results from the study by Hatzidakis et al. showed 86 and 87% clinical improvement rates for the PC and conservative groups, respectively, showing that PC has no advantage over conservative treatment [17]. In other studies by Bundy et al. [11] and McKay et al. [16], 100 and 85% respective clinical improvement rates were found for PC. However, the main disadvantage of these studies was the absence of a conservatively managed control group.

In the 13-year retrospective analysis period, the possible mean time frame for obtaining data was 4.5 and 4.4 months for the study and control groups, respectively. The present study revealed an overall long-term follow-up mortality rate of 26.5% (n = 35) and 30.4% (n = 38), for these respective groups. In one of the largest series studied by Bundy et al., the mortality rate was 6.8% during the seven-year period from catheter placement. In another study, it was 35.8% for 10-year follow-up [18]. However, when reviewing these studies, we could not find information regarding the mean time frame of data availability in hospital records during the study periods. Our long-term mortality rate was higher than in the Bundy et al. study. We think the possible factors for this are as follows: (1) The mean age of our PC group was 74.8, while it was 67 for the aforementioned study; (2) 56.8% of our patients had an APACHE score over 15; and (3) 54% of our patients were in an ICU on admission. The study by Bundy et al. also lacks TG18 grading for AC severity as well as APACHE II or ASA scoring systems for evaluating general clinical status. Thus, we could not evaluate the objective clinical status of their patients compared to the present study. Another weakness of these studies is the absence of one-month mortality rates, which might show the possible early effects of PC intervention in high-risk critically ill patients with AC.

This study has several limitations. During the 13-year time frame, some data loss may have occurred in hospital archives due to the large amount of clinical data and the long timespan, which might have affected our results. Another important point is that we did not perform a comparison with the high-risk, critically ill patients who underwent cholecystectomy during the same time frame. However, this could cause selection bias, as pointed out by McKay et al. [16]. They also reported that it is unclear whether it would be advantageous or not if that group of patients underwent cholecystectomy. It has also been reported that immediate PL as a definitive treatment method might be superior to PC, because of the high rate of recurrent AC symptoms after PC [19]. Lastly, we did not analyze the cost-effectiveness in relation to the study and control groups.

Conclusions

PC, compared to conservative treatment, was found to be a safe and efficient way of managing AC in high-risk critically ill patients, especially those in an ICU. We recommend PC as the initial treatment of choice for this specific group of patients. We would also like to suggest that PC may be a definitive treatment option for acalculous AC in this group of patients. Additionally, we also recommend the transperitoneal approach as an easily performed, safe, and efficient method for PC.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study 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. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Macchini D, Degrate L, Oldani M, Leni D, Padalino P, Romano F et al. Timing of percutaneous cholecystostomy tube removal: systematic review. *Minerva Chir.* 2016; 71: 415–26.
2. Boland GW, Lee MJ, Leung J, Mueller PR. Percutaneous cholecystostomy in critically ill patients: early response and final outcome in 82 patients. *AJR Am J Roentgenol.* 1994;163(2):339–42.
3. Kuan LL, Oyebola T, Mavilakandy A, Dennison AR, Garcea G. Retrospective analysis of outcomes following percutaneous cholecystostomy for acute cholecystitis. *World J Surg.* 2020; 44(8):2557–61.
4. Radder RW. Percutaneous cholecystostomy. *AJR Am J Roentgenol.* 1982; 139(6):1240–1.
5. Radder RW. Ultrasonically guided percutaneous catheter drainage for gallbladder empyema. *Diagn Imaging.* 1980; 49(6):330–3.
6. Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci.* 2018; 25(1):41–54.
7. Knaus WA, Zimmerman JE, Wagner DP, Draper EA, Lawrence DE. APACHE-Acute Physiology and chronic health evaluation: a physiologically based classification system. *Crit Care Med.* 1981; 9(8):591–7.
8. Akhan O, Akinci D, Ozmen MN. Percutaneous cholecystostomy. *Eur J Radiol.* 2002; 43(3):229–36.
9. Jung BH, Park JI. Impact of scheduled laparoscopic cholecystectomy in patients with acute cholecystitis, following percutaneous transhepatic gallbladder drainage. *Annals Hepatobiliary Pancreat Surg.* 2017; 21(1):21–9.
10. Hatzidakis AA, Prassopoulos P, Petinarakis I, Sanidas E, Chrysos E, Chalkiadakis G, et al. Acute cholecystitis in high-risk patients: percutaneous cholecystostomy vs conservative treatment. *Eur Radiol.* 2002; 12(7):1778–84.
11. Bundy J, Srinivasa RN, Gemmete JJ, Shields JJ, Chick JFB. Percutaneous cholecystostomy: long-term outcomes in 324 patients. *Cardiovasc Intervent Radiol.* 2018; 41:928–34.
12. Welschbillig-Meunier K, Pessaux P, Lebigot J, Lermite E, Aube Ch, Brehant O et al. Percutaneous cholecystostomy for high-risk patients with acute cholecystitis. *Surg Endosc.* 2005; 19(9):1256–9.
13. Griniatsos J, Petrou A, Pappas P, Revenas K, Karavokyros I, Michail OP, et al. Percutaneous cholecystostomy without interval cholecystectomy as definitive treatment of acute cholecystitis in elderly and critically ill patients. *South Med J.* 2008; 101(6):586–90.
14. Kirshtein B, Bayme M, Bolotin A, Mizrahi S, Lantsberg L. Laparoscopic cholecystectomy for acute cholecystitis in the elderly: is it safe? *Surg Laparosc Endosc Percutan Tech.* 2008; 18(4):334–9.
15. Kiviniemi H, Mäkelä JT, Autio R, Tikkakoski T, Leinonen S, Siniluoto T et al. Percutaneous cholecystostomy in acute cholecystitis in high-risk patients: an analysis of 69 patients. *Int Surg.* 1998; 83(4):299–302.
16. McKay A, Abulfaraj M, Lipschitz J. Short- and long-term outcomes following percutaneous cholecystostomy for acute cholecystitis in high-risk patients. *Surg Endosc.* 2012; 26(5):1343–51.
17. Hatjidakis AA, Karampekios S, Prassopoulos P, Xynos E, Raissaki M, Vasilakis SI et al. Maturation of the tract after percutaneous cholecystostomy with regard to the access route. *Cardiovasc Interv Radiol.* 1998; 21(1):36–40.
18. Joseph T, Unver K, Hwang GL, Rosenberg J, Sze DY, Hashimi S et al. Percutaneous Cholecystostomy for Acute Cholecystitis: Ten-Year Experience. *J Vasc Interv Radiol.* 2012; 23(1):83–8.e1.
19. Morse BC, Smith JB, Lawdahl RB, Roettger RH. Management of acute cholecystitis in critically ill patients: contemporary role for cholecystostomy and subsequent cholecystectomy. *Am Surg.* 2010; 76(7):708–12.

How to cite this article:

Oğuzhan Özdemir, Volkan Kızılgöz, Türkhun Çetin, Doğan Gönüllü. Percutaneous cholecystostomy for management of acute cholecystitis in severely ill patients. *Ann Clin Anal Med* 2021;12(Suppl 2): S142-148