Beware of the interval cholecystectomy

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BACKGROUND: Despite limited data regarding the indications and effectiveness of percutaneous cholecystostomy (PC) in the treatment of acute cholecystitis (AC), usage has increased by over 500% since 1994. Many of these patients subsequently undergo interval cholecystectomy (IC), a procedure that has not been rigorously evaluated. This aim of this study was to quantify the morbidity and mortality associated with the IC.

METHODS: We included all consecutive adult patients (>18 years old) who underwent PC and IC from January 2008 to December 2013. Conversion rate, length of operation, biliary injury, estimated blood loss, surgical site infection, length of stay, and mortality were compared with 227 patients who underwent cholecystectomy for AC during the same time interval.

RESULTS: Of 18,501 patients who underwent cholecystectomy, 337 had at least one PC and 177 underwent subsequent IC. Compared with patients undergoing cholecystectomy for clinically diagnosed AC, patients undergoing IC were older (69.8 vs. 54.9 years; $p < 0.001$), thinner (body mass index, 28.7 vs. 31.1; $p = 0.002$), more complex by Tokyo grade (1.9 vs. 1.1; $p < 0.001$), and American Society of Anesthesia classification (3.0 vs. 2.5; $p < 0.001$), had longer operative times (120.7 vs. 92.5 minutes; $p < 0.0001$), more blood loss (30 vs. 15 mL; $p = 0.01$), and increased rates of conversion (26.6% vs. 12.8%; $p < 0.001$), surgical site infection (12.4% vs. 0.4%; $p < 0.001$), bowel injury (6.2% vs. 0.4%; $p < 0.001$), and 1-year mortality (15.3% vs. 0.4%; $p < 0.01$). Nonsignificant trends included significant biliary tract injury (3 vs. 0; $p = 0.08$) and longer length of stay (7.3 vs. 4.8 days; $p = 0.39$). Linear regression identified body mass index ($p = 0.03$), time from admission to PC ($p = 0.03$), and American Society of Anesthesia classification ($p = 0.06$) as predictors of a difficult IC.

CONCLUSION: PC has been widely adopted with limited description of the subsequent IC. Our data detail the factors predicting the challenges of IC and document that it is a difficult operation associated with significant morbidity. (*J Trauma Acute Care Surg.* 2017;83: 55–60. Copyright © 2017 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Therapeutic, level IV.

KEY WORDS: Interval cholecystectomy; percutaneous cholecystostomy; early cholecystectomy.

The management of gallstones has evolved significantly since Bobbs performed the first cholecystotomy in 1867.[1] Cholecystectomy via a Kocher incision, initially performed by Langenbuch in Berlin in 1882, remained the gold standard for treatment of symptomatic cholelithiasis for over a century. Muhe's introduction of the laparoscopic approach to cholecystectomy in 1985 was met with significant skepticism. That technique, however, introduced in the United States by McKernan and Saye in 1988, has become the standard for treating patients with symptomatic cholelithiasis and mild or moderate acute cholecystitis (AC) conferring reduced morbidity and length of hospital stay.

The management of AC in high-risk surgical patients, those who present with prolonged symptomatology, or grade 3 AC is controversial.[2–4] Some authors advocate early surgical intervention relying on the technical expertise and judgment of the surgeon. Others recommend stabilizing the patient via percutaneous cholecystostomy (PC) due to concerns over higher conversion rates, bile duct injury, and mortality associated with urgent surgical intervention.[2,4–12] Despite minimal evidence demonstrating improved outcomes with PC, it is being used more frequently, in less morbid patients, and for logistical considerations.[13–16] In the Medicare population, PC use increased by 567% from 1994 to 2009 and several current studies acknowledge expanded PC usage for convenience or lack of operating room availability.[17] When placed, PC is an effective temporizing measure in critically ill patients with AC or in patients with moderate AC (white cell count, > 18 K; painful mass; symptoms, > 72 hours; or > 8 mm wall thickness).[2,6,18,19] However, the subsequent management of the PC remains individualized and the duration before, removal of, or the subsequent need for and performance of interval cholecystectomy (IC) is not standardized. Additionally, the morbidity of the IC has not been well studied and characterized, yet should be incorporated into the complex decision making of whether or not to place a PC. In this study, we hypothesized that the conversion rate, infection rate, bile duct injury, and mortality of the IC is significant.

PATIENTS AND METHODS

Study Design

We conducted a retrospective cohort analysis of all patients admitted to any of seven hospitals within our health system who underwent cholecystectomy between January 2008 and December 2013 using the International Classification of Diseases—9th Rev.—Clinical Modification procedure codes 51.21 to 51.24. All patients carried the preoperative diagnosis of AC as listed on the operative report. Patients who underwent concomitant procedures at the time of cholecystectomy or those with a preoperative diagnosis other than AC were excluded. Our primary objective was quantify the morbidity and mortality associated with the IC. This study was approved by the institutional review board at the University of Pittsburgh (PRO 14120409).

Patient Selection and Variables

We identified all patients 18 years or older who received a cholecystostomy tube as defined by International Classification of Diseases—9th Rev.—Clinical Modification codes 51.01 to 51.04. As our primary emphasis was on the combined management and outcome of PC followed by cholecystectomy, subjects who underwent cholecystostomy without subsequent cholecystectomy were excluded. Our primary outcome was 1-year mortality as defined by date of death reported in a regional electronic database. Secondary outcomes included 30-day mortality, perioperative complications, and hospital lengths of stay.

We abstracted data on patient age, sex, race, body mass index (BMI), and prior abdominal surgery listed in surgical history. Measures of severity of illness included the preoperative use of vasopressors and the American Society of Anesthesia (ASA) and Tokyo classifications.

Interventions

Patients were defined as undergoing PC or not (no-PC) before cholecystectomy. We abstracted data regarding the

TABLE 1. IC Demographics Compared With Cholecystectomy for AC

	PC Laparoscopic (n = 119)	PC Converted (n = 43)	PC Open (n = 15)	PC Total (n = 177)	No-PC Total (n = 227)	p
Age: mean (SD), y	69.0 (15.4)	69.8 (15.1)	76.8 (15.1)	69.8 (15.4)	54.9 (18.8)	<0.001*
BMI, mean (SD)	29.3 (7.2)	28.8 (6.7)	24.7 (4.3)	28.7 (7.0)	31.1 (8.0)	0.002*
Race, n (%)						
White	109 (91.6)	40 (93.0)	14 (93.3)	163 (92.1)	190 (84.1)	0.02*
Black	8 (6.7)	3 (7.0)	1 (6.7)	12 (6.8)	34 (15.0)	0.011*
Other	2 (1.7)	0 (0)	0 (0)	2 (1.1)	2 (0.9)	1
Male sex, n (%)	66 (55.5)	29 (67.4)	10 (66.7)	105 (59.3)	103 (45.4)	0.007*
ASA class, mean (SD)	3.0 (0.7)	3.0 (0.7)	3.3 (0.5)	3.0 (0.7)	2.5 (0.7)	<0.001*
Tokyo Grade, mean (SD)	1.8 (0.8)	2.1 (0.6)	2.0 (0.7)	1.9 (0.7)	1.1 (0.4)	<0.001*
Previous surgery, n (%)	41 (34.5)	19 (44.2)	6 (40.0)	66 (37.3)	76 (33.6)	0.46

*Statistical significance between PC total and no-PC total.

following perioperative outcomes: estimated blood loss (EBL), duration of surgery, intraoperative placement of gallbladder fossa drain, and endoscopic retrograde cholangiopancreatography within 1 year after surgery. EBL was not normally distributive with maximal blood loss being 800 mL, 1,400 mL, and 5,000 mL for Tokyo Grades 1, 2, and 3.

We defined complexity of operative intervention as a −22 modifier to the current procedural terminology code or surgeon description of a difficult procedure in the operative report, subtotal cholecystectomy, or the need for hepatic resection and abstracted the rate of conversion to open. The reasons for conversion to open were classified as the following: (1) a hostile abdomen due to adhesions, (2) a hostile right upper quadrant due to inflammation, (3) inability to define anatomy, (4) the result of a surgical complication, (5) need for common bile duct exploration, or (6) need for hepatic resection.

Perioperative complications were defined as bile duct injury, surgical site infection, and bowel injury. Bile duct injuries were classified using the Strasberg classification.[20] We defined superficial infections as those which required opening of the incision and deep infections as those visible on imaging or which required subfascial drainage. Bile and tissue culture data were collected after cholecystostomy and cholecystectomy. The final pathologic diagnoses after cholecystectomy were abstracted and include (1) type of cholecystitis (acute, chronic, xanthogranulomatous, or any combination of the three), (2) cholelithiasis or microlithiasis, (3) gangrene or necrosis, (4) ulceration or perforation, and (5) metastatic or primary gallbladder malignancy. Bowel injuries were defined as serosal injury or full thickness enterotomy as dictated by the surgeon in the operative report.

Statistical Analyses

Univariate analyses were performed using Student's *t* test, Pearson's χ^2, and Wilcoxon rank-sum test as appropriate. We performed a random-effects, multivariable logistic regression

TABLE 2. IC Outcomes Compared With Cholecystectomy for AC

	PC Laparoscopic (n = 119)	PC Converted (n = 43)	PC Open (n = 15)	PC Total (n = 177)	No PC Total (n = 227)	p
Conversion rate, n (%)	—	—	—	43 (26.6)	29 (12.8)	<0.001*
OR time: mean (SD), min	101.3 (46.5)	178.6 (73.8)	112.9 (55.7)	120.7 (64.0)	92.5 (49.4)	<0.001*
EBL: median (LQ, UQ), mL	20 (5–50)	225 (50–400)	100 (12.5–200)	30 (5–100)	15 (10–50)	0.011*
HLOS: mean (SD), d	5.0 (5.4)	10.4 (8.0)	16.8 (22.6)	7.3 (9.6)	4.8 (4.5)	0.39
ICU stay: mean (SD), d	0.2 (0.9)	1.7 (4.8)	5.7 (15.7)	1.0 (5.4)	0.1 (0.5)	0.009*
30 d Mortality, n (%)	0 (0)	2 (4.9)	1 (6.7)	3 (1.7)	0 (0)	0.08
1 y Mortality, n (%)	15 (12.8)	6 (15.8)	5 (33.3)	26 (15.3)	1 (0.4)	<0.001*
SSI total, n (%)	6 (5.0)	10 (23.3)	6 (40.0)	22 (12.4)	1 (0.4)	<0.001*
Superficial, n (%)	3 (2.5)	7 (16.3)	3 (20.0)	13 (7.3)	1 (0.4)	<0.001*
Deep, n (%)	3 (2.5)	3 (7.0)	3 (20.0)	9 (5.1)	0 (0)	0.001*
Biliary injury total, n (%)	3 (2.5)	5 (11.6)	2 (13.3)	10 (5.7)	0 (0)	<0.001*
Type A, n (%)	3 (2.5)	2 (4.7)	2 (13.3)	7 (4.0)	0 (0)	0.003*
Type D, n (%)	0 (0)	3 (7.0)	0 (0)	3 (1.7)	0 (0)	0.08
Bowel injury total, n (%)	2 (1.7)	7 (16.3)	2 (13.3)	11 (6.2)	1 (0.4)	0.001*
Serosal tear, n (%)	2 (1.7)	5 (11.6)	2 (13.3)	9 (5.1)	1 (0.4)	0.006*
Full thickness, n (%)	0 (0)	2 (4.7)	0 (0)	2 (1.1)	0 (0)	0.19

*Statistical significance between PC total and no-PC total.
OR, operating room; UQ, upper quartile; LQ, lower quartile; HLOS, hospital length of stay; ICU, intensive care unit; SSI, surgical site infection.

TABLE 3. Pathologic Findings After Cholecystectomy

	PC Laparoscopic n = 119	PC Converted n = 43	PC Open n = 15	PC Total n = 177	No PC Total n = 227	*p*
No GB tissue, n (%)	0 (0)	1 (2.3)	1 (6.7)	2 (1.13)	0 (0)	0.10
Acute, n (%)	23 (19.3)	13 (30.2)	3 (20.0)	39 (22.0)	84 (37.0)	0.002*
Chronic, n (%)	48 (40.3)	9 (20.9)	1 (6.7)	58 (32.8)	57 (25.1)	0.10
AC on CC, n (%)	42 (35.3)	19 (44.2)	8 (53.3)	69 (39.0)	72 (31.7)	0.14
XG, n (%)	0 (0)	1 (2.3)	0 (0)	1 (0.6)	1 (0.4)	1
AC on XG, n (%)	1 (0.8)	0 (0)	2 (13.3)	3 (1.7)	4 (1.8)	1
AC, CC, XG, n (%)	5 (4.2)	0 (0)	0 (0)	5 (2.8)	0 (0)	0.02*
No inflammation, n (%)	0 (0)	0 (0)	0 (0)	0 (0)	7 (3.1)	0.02*
Stones/sludge, n (%)	99 (83.2)	36 (83.7)	11 (73.3)	146 (82.5)	195 (85.9)	0.41
Ulceration, n (%)	14 (11.8)	8 (18.6)	3 (20.0)	25 (14.1)	14 (6.2)	0.01*
Perforation, n (%)	3 (2.5)	1 (2.3)	1 (6.7)	5 (2.8)	60 (2.6)	<0.001*
Necrosis/gangrene, n (%)	17 (10.1)	6 (14.0)	1 (6.7)	19 (10.7)	33 (14.5)	0.30
Metastatic lesion, n (%)	2 (1.7)	1 (2.3)	0 (0)	3 (1.7)	0 (0)	0.08

*Statistical significance between PC total and no-PC total.
GB, gallbladder; CC, chronic cholecystitis; XG, xanthogranulomatous cholecystitis.

to assess the association between PC and the primary outcome of death. We calculated crude and adjusted odds ratios with 95% confidence intervals, adjusting for covariates specified a priori as potential confounders. For each analysis, we adjusted for age, sex, race, ASA, Tokyo grade, BMI, prior abdominal surgery, and year. We explored whether rates of care and outcome varied by hospital and year.

We conducted all statistical analyses using XLSTAT software (Addinsoft, New York, NY). A *p* less than 0.05 was considered statistically significant.

TABLE 4. Indicators of Difficulty and Outcomes of IC by Tokyo Grade

	Tokyo Grade 1 (n = 47)	Tokyo Grade 2 (n = 89)	Tokyo Grade 3 (n = 38)	*p*
OR time, min	101.9 ± 44.7 (39.0–252.0)	129.7 ± 69.7 (40.0–366.0) n = 88	124.6 ± 67.8 (39.0–332.0)	0.05
EBL, mL	99.7 ± 171.4 (5.0–800.0) n = 34	117.8 ± 236.7 (5.0–1400.0) n = 63	313.9 ± 1030.8 (5.0–5000.0) n = 23	0.20
Surgery type				
Laparoscopic	37 (78.7%) of 47	56 (62.9%) of 89	23 (60.5%) of 38	0.21
Converted	6 (12.8%) of 47	26 (29.2%) of 89	11 (29.0%) of 38	
Open	4 (8.5%) of 47	7 (7.9%) of 89	4 (10.5%) of 38	
Length of stay, d	5.8 ± 5.9	6.3 ± 5.7	11.3 ± 17.1	0.01
Postoperative ICU, d	0.2 ± 0.8	0.7 ± 3.0	2.8 ± 10.7	0.08
30-d mortality	1 (2.1%) of 47	2 (2.3%) of 87	0 (0.0%) of 38	1.00
1-y mortality	8 (17.0%) of 47	11 (13.1%) of 84	7 (18.4%) of 38	0.70
Infection				
None	45 (95.7%) of 47	77 (86.5%) of 89	33 (86.8%) of 38	0.53
Superficial	1 (2.1%) of 47	5 (5.6%) of 89	4 (10.5%) of 38	
Deep	1 (2.1%) of 47	4 (4.5%) of 89	1 (2.6%) of 38	
Both	0 (0.0%) of 47	3 (3.4%) of 89	0 (0.0%) of 38	

RESULTS

A total of 18,501 patients underwent cholecystectomy during the 6-year period, and 337 (1.8%) of these patients had at least one PC. Of those undergoing PC, 177 (52.5%) underwent subsequent IC. Mean age was 69.8 years, 59.3% were men, 92.1% were white, 37.3% had previous abdominal surgery, the mean Tokyo classification was 1.9, and the mean ASA classification was 3.0 (Table 1).

Index Admission for PC

During the index hospitalization that included placement of the PC, the mean leukocytosis was 14.4 × 10^3/μL; serum creatinine, 1.5 mg/dL; and total bilirubin, 1.5 mg/dL. Vasopressor use at time of placement was present in 4.5% of patients. The indications for PC were chronic comorbidities (41), biliary sepsis (29), prolonged duration of symptoms (29), acute comorbidities (21), imaging suggesting hostile anatomy (16), and recent surgery (10). The time from admission to PC averaged 2.7 (SD, 10.7) days. We did observe an absolute increase in the number of PC and IC performed per year throughout the study period. PC tube re-insertion was required once in 17 (9.6 %) patients, twice in two (1.1%) patients, and more than twice in two (1.1%) patients. The PC to cholecystectomy interval was

TABLE 5. Reason the Cholecystectomy Was Converted From Laparoscopic to Open

	PC (n = 43)	No PC (n = 29)	*p*
Hostile abdomen/adhesions, n (%)	7 (16.3)	14 (48.3)	0.007*
Hostile RUQ, n (%)	25 (58.1)	11 (34.5)	0.15
Unable to obtain critical view, n (%)	5 (11.6)	5 (17.2)	0.51
Complication, n (%)	5 (11.6)	2 (6.9)	0.69
CBD exploration, n (%)	1 (2.3)	0 (0)	1
Liver lesion, n (%)	0 (0)	1 (3.5)	0.40

*Statistical significance between PC Total and No PC Total.
RUQ, right upper quadrant; CBD, common bile duct.

68.7 (SD, 51.9) days and the PC was in place at the time of surgery in 145 (82%) patients. For the index admission, the IC group length of stay was 10.8 (SD, 11.6) days.

Operative and Postoperative Data

For patients undergoing IC, the operation was difficult and associated with significant complications (Table 2). Logistic regression identified BMI ($p = 0.03$), time from admission to PC ($p = 0.03$), and ASA classification ($p = 0.06$) as predictors of a difficult IC.

For the 144 patients with culture results available, 39% (55) were sterile, 41% (58) monomicrobial, and 20% (28) polymicrobial. Gram-negative rods (*Escherichia coli* [38] and Klebsiella [23]) were most frequent (51%) followed by Gram-positive cocci (enterococcus [16] and strep viridans [12]) and anaerobes (11%). Final pathology results are listed in Table 3 and are notable for the lack of gallbladder tissue in two of the IC specimens. Operative data and final pathology did not differ among the hospitals. Tokyo Grade correlated with the length of the operation and hospital length of stay (Table 4).

Outcomes: PC versus No-PC

A comparison group for the IC population does not exist. The Cochrane Collaboration estimates that because the majority of important outcomes occur rarely, a clinical trial powered adequately to measure differences in bile duct injury and other serious complications might involve more than 50,000 people.[3] Additionally, the IRB study design focused on the outcomes of the IC but not data on the PC but no-IC group, information that would be valuable in deciding whether or not to place a PC. To provide a comparison, we randomly identified 500 patients who underwent laparoscopic cholecystectomy (LC) during the study period. To select the more difficult cases, we included only those with the preoperative diagnosis of AC, excluding 273 patients with the preoperative diagnosis of symptomatic cholelithiasis, biliary dyskinesia, or chronic cholecystitis, and those undergoing concomitant nonbiliary tract surgery. Compared with the remaining 227 patients, the IC group experienced higher conversion rates (26.6% vs. 12.8%, $p < 0.001$), surgical site infections (12.4 % vs. 0.4%, $p < 0.001$), longer operative times (120.7 vs. 92.5 minutes, $p < 0.001$), a more difficult operation, less hostile abdomen, and more hostile right upper quadrant per the operative note or −22 modifier (42.9% vs. 16.7%, $p = 0.005$; 16.3% vs. 48.3%, $p < 0.001$, and 58.1% vs. 34.5%, $p < 0.001$), increased type A biliary tract injuries (7 vs. 0, $p = 0.003$) and demonstrated a trend toward significance for type D injuries (3 vs. 0, $p = 0.08$). Reasons for converting a LC to an open procedure are listed in Table 5. Subjects receiving a PC experienced elevated 1-year mortality (15.3% vs. 0.4%, $p < 0.001$). In multivariate regression, PC was associated with an increased risk of 1 year mortality ($p = 0.005$) and a trend toward conversion to an open procedure: adjusted odds ratios 1.71 (95% confidence interval, 0.92 to 3.17, $p = 0.09$). There was no significant association with blood loss.

DISCUSSION

In high-risk surgical patients with AC, those presenting with prolonged symptoms or recent complex surgery, and those with imaging or physical findings, suggesting a hostile right upper quadrant, PC followed by IC as an alternative to early cholecystectomy is being increasingly used despite many unresolved controversies and the lack of improved outcomes data.[2,15] In this observation study, we observed that the majority of PCs were placed in patients of low Tokyo grade, who did not demonstrate hemodynamic instability or vasopressor use, and who had not had prior abdominal surgery. This practice is a clear deviation from the contemporary recommendations. Nonetheless, those undergoing IC after PC experienced much more complicated AC and an increased risk of death, suggesting that heightened attention be given to this complex patient population.

First described in 1980, PC was initially recommended in patients with Tokyo Grade 3 equivalent cholecystitis or in high-risk surgical patients who would not tolerate anesthesia. PC has a technical success rate of greater than 90% and, in combination with antibiotics, is successful in stabilizing over 85% of patients who present with grade 3 AC.[18,21,22] Recently, indications have expanded to include patients with grades 1 and 2 AC or for diagnostic or logistical reasons.[15] Medicare tables document a rapid and geographically dependent growth in the utilization of PC despite the lack of consensus on indications or patient selection and scant evidence demonstrating improved morbidity or mortality.[13,15,16] The theoretic benefit of using a PC to effectively temporize patients and performing a delayed cholecystectomy under controlled circumstances should be tempered by the lack of supportive evidence and recent reports documenting very good outcomes from early cholecystectomy in elderly high-risk patients and in patients on chronic hemodialysis.[23] Furthermore, there is a real, albeit small, risk of significant complications associated with PC tubes. The role for PC is under active investigation in the study Acute Cholecystitis in high risk surgical patients: percutaneous cholecystostomy versus laparoscopic cholecystectomy (CHOCOLATE trial), forums such as the American College of Surgeons General Surgery Digest, and online surveys querying surgeons regarding the use of PC are attempts to clarify the optimal treatment for AC in high-risk patients.

For patients who have had a PC, guidelines for tube management and the indications for and difficulty of the subsequent IC are not well established. Temporizing drainage should be used only if the morbidity and mortality rates for early cholecystectomy in high-risk patients with AC are greater than the combined risks of PC placement, tube management until surgery, and the subsequent IC, recognizing that only about 40% of patients subsequently undergo IC.[4,8,9,24] Strikingly, we observed that these characteristics were not present in the majority of subjects undergoing PC + IC studied herein. Clearly, there are other aspects of the patient or system that are providing a strong influence to deviate from the current body of guidelines. Although the IC is only one piece in this puzzle, our data clearly demonstrates that the IC after PC is a challenging procedure associated with statistically higher rates of conversion, surgical site infections, and 1-year mortality, more blood loss, longer operative times, and a trend toward higher rates of significant biliary tract injury. For high-risk patients with AC, the treatment algorithm of early cholecystectomy versus PC must account for this delayed but elevated morbidity.[25] Our recommendation is that PC for AC should be used primarily in patients who would not tolerate anesthesia or in patients with a hostile abdomen.

The difficulty of the IC varies for individual patients, and 67% of the patients have their gallbladder successfully removed laparoscopically. Being able to predict pre-PC how difficult the subsequent IC will be could affect the decision for early cholecystectomy versus PC. We identified increased time from admission to PC, elevated BMI, and higher ASA classification as pre-PC predictors that the subsequent IC would take longer or have a higher laparoscopic to open conversion rate. The presence of any of these factors could play a limited role in the PC decision algorithm although additional corroborative studies need to be conducted. Other findings that may be predictive of a difficult cholecystectomy, although not found to be significant in our study, include male sex, age, duration of symptoms, elevated white cell count, previous upper abdominal surgery, and inflammation, gallbladder wall thickness, pericholecystic fluid, or a contracted gallbladder on imaging.[2,8,9,11,24]

This analysis is limited by its retrospective nature and sample size. Having only 43 converted cases limits the ability to determine predictors of a difficult case. Additionally, we cannot predict what the morbidity or mortality would have been for the patients who underwent IC had they undergone early cholecystectomy. Also, although the study was performed at one health care system, practices between hospitals may not be consistent and PC usage over time increased. Using data from multiple surgeons over seven hospitals could be interpreted as a strength because practice diversity should be more reflective of national trends.

CONCLUSION

The increased usage of PC in the treatment of AC has not been evidenced based. The indications for placement and the need for IC are not well defined, and the morbidity of the IC has not been well-documented. Our data demonstrate that the IC is a difficult procedure and is associated with significantly higher rates of conversion, infection, 1-year mortality, and biliary tract injury. Because the mortality rate for early cholecystectomy in high-risk patients is low and the IC is a difficult procedure, surgeons should be judicious in their decision to recommend a PC.

AUTHORSHIP

J.A. and K.S. helped in the design, data acquisition, analysis and interpretation of the data, and helped write the article. R.A. and W.M. helped in the study design and data acquisition. M.S. helped acquire data and write the article. M.R. helped analyze and interpret the data and write the article. A.P. helped design the study and revise the article.

DISCLOSURE

The authors declare no conflicts of interest.

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