



The impact of empiric endoscopic biliary sphincterotomy on future gallstone-related complications in patients with non-severe acute biliary pancreatitis whose cholecystectomy was deferred or not performed

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Abstract

Background Early cholecystectomy (EC) is recommended in patients with acute biliary pancreatitis (ABP). In real-life practice, cholecystectomy is frequently deferred due to various reasons and delayed cholecystectomy (DC) is performed instead. Endoscopic sphincterotomy (ES) is an alternative to prevent recurrent pancreatitis, however other gallstone-related complications (GCs) may still develop. We aimed to determine the impact of ES on future GCs in patients with non-severe acute biliary pancreatitis whose cholecystectomy was deferred or not performed.

Methods During 2006–2016, we included patients with non-severe ABP while those with severe pancreatitis and concurrent cholangitis were excluded. GC events were compared between those who had DC with ES and those who had DC without ES. A similar comparison was made in patients with and without ES who did not receive cholecystectomy.

Results Of 266 patients with ABP, non-severe ABP was identified in 146. Only 16 (11%) had EC. Of patients with non-severe ABP who underwent DC ($n=88$), recurrent ABP in the ES group was lower than those from the non-ES group (2% vs. 17%; $p=0.01$). Acute cholecystitis was found in 0%, 6% and 10% of patients with EC, DC and those without cholecystectomy ($p=0.39$). Of those who did not undergo cholecystectomy ($n=42$), recurrent ABP in the ES group was still lower than the non-ES group (4% vs. 36%; $p=0.006$). ES related complications were mild pancreatitis (4%) and post sphincterotomy bleeding (5%).

Conclusions In patient with non-severe ABP, ES is an alternative to reduce recurrent ABP, however without EC, future cholecystitis may still develop.

Keywords Acute biliary pancreatitis · Endoscopic sphincterotomy · Cholecystectomy

Abbreviations

ABP Acute biliary pancreatitis
DC Delayed cholecystectomy

ACG The American College of Gastroenterology
AGA The American Gastroenterological Association
Institute
ES Endoscopic sphincterotomy
ERCP Endoscopic retrograde cholangiopancreatography
CBD Common bile duct
CCI Charlson Comorbidity Index
SD Standard deviation
UK The United Kingdom

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According to guidelines from many international societies, early cholecystectomy (EC) is recommended in patients with acute biliary pancreatitis (ABP) to reduce the risk of recurrence, particularly in mild disease [1–6]. This

recommendation is based on observational studies, which showed a high risk of recurrent ABP, reaching approximately 20–60% in patients undergoing delayed cholecystectomy (DC) [7–9]. Recently, a multicenter randomized controlled trial from the Dutch Pancreatitis Study Group confirmed the lower rate of recurrent gallstone-related complications (GCs) (17% vs. 5%; $p=0.002$) with very low risk of cholecystectomy related complications in patients with mild ABP who underwent the same-admission cholecystectomy, compared with those who underwent the interval cholecystectomy [10].

In real-life practice, cholecystectomy might be deferred due to various reasons such as scarce theater capacity, patient instability during ABP episode, and laboratory result derangement [11–18]. Moreover, the risks of surgery may increase in patients with multiple comorbid diseases; hence, cholecystectomy is frequently deferred or not performed in these patients. Based on several series, endoscopic sphincterotomy (ES) may be performed to reduce the risk of recurrent ABP in the selected groups such as unsuitable surgical candidates [19–23]. The potential advantages of ES are to improve the disease course by providing early decompression of the pancreaticobiliary system, to remove retained common bile duct (CBD) stones, or to prevent recurrent attacks [24]. However, this concept has not been adopted by the standard guideline. Recent American Gastroenterological Association Institute (AGA) guidelines advises against the routine use of urgent ERCP in patients with ABP and no cholangitis [25]. Of note, this statement was addressed as conditional recommendation based on the low quality of evidence. Because post-endoscopic retrograde cholangiopancreatography (ERCP) pancreatitis can develop in 2–4% of patients [26]. The risks of ERCP-related adverse events should be weighted in the assessment.

Although previous series showed ES as an alternative option to prevent recurrent ABP, these data were limited in patients who were considered unfit for surgery and severe ABP [19–21, 23]. In non-severe ABP patients with DC as a plan, performing prophylactic ES to reduce the risk of recurrent ABP while waiting for DC has been practically performed but the advantage and disadvantage of this practice have never been evaluated. The primary objective of our study was to compare the incidences of recurrent attacks of ABP and other GCs between patients with non-severe ABP who had ES with those without ES and subgroup analyses were also done in those with DC and those with gallbladder left in situ. The secondary objective was to observe the incidence of ES related adverse events.

Materials and methods

Study population

Based on our medical database, we identified all patients who were diagnosed with ABP between January, 2006 and December, 2016 using International Classification of Diseases, 10th revision (ICD-10) code of K 85.1. The diagnosis of ABP was based on clinical presentation of acute pancreatitis—two out of three of the following criteria: typical pancreatic pain, amylase or lipase level at least three times above the reference ranges, or imaging criteria consistent with acute pancreatitis (computed tomography, magnetic resonance imaging, or transabdominal ultrasound) and confirmation of the presence of gallstones in at least one imaging study. Exclusion criteria included severe ABP (based on the revised Atlanta classification and definitions by international consensus 2012) [27], concurrent cholangitis and history of previous cholecystectomy. EC group was definitely separated from DC group. EC was defined when cholecystectomy was performed within the first 14 days of ABP regardless of the same admission or elective admission and any cholecystectomy that performed after 14 days was considered as DC. The indication of ERCP included CBD stone seen on imaging studies and evidence of passing stone with more stones left in the gallbladder. In our center, we experienced similar rates of complication between ERCP without sphincterotomy and ERCP with sphincterotomy. In addition, the idea of ES is to provide better spontaneous passage of small stones through CBD (stones from the GB that left in situ). Therefore, we provide pre-emptive ES in our protocol for those patients. Patients were divided into four groups according to the plans for cholecystectomy and whether ERCP with ES (ERCP–ES) was performed or not; (1) those who had DC with ERCP–ES, (2) those who had DC with no ERCP, (3) those who did not have cholecystectomy but had ERCP–ES and (4) those who did not have any intervention at all. Relevant clinical data, including age, gender, Charlson Comorbidity Index (CCI), laboratory findings, clinical status upon admission, imaging studies, time to either ES or definitive cholecystectomy, time to follow up and adverse events during the waiting period for DC, were abstracted from medical records. Our local Institutional Review Board approved the final study protocol.

Admission

All patients with non-severe ABP were admitted for aggressive intravenous hydration and nothing by mouth protocol was placed during the first few days. Upon

admission, all patients were seen by our surgical team. Due to the scarcity of cholecystectomy slots, unless an urgent operative slot was available, the delayed approach was selected primarily to facilitate operative theater capacity. If the patient was not a surgical candidate, cholecystectomy would not be considered at all. After clinical improvement of ABP, these patients including those with deferred cholecystectomy and those with no plan for surgery would be subjected to ERCP depending on the judgment of the consultant gastroenterologists who usually offers ERCP and ES in those who potentially have retained CBD stone or potentially develops recurrent stones in CBD as mentioned earlier. All ERCPs including ES were performed by experienced senior endoscopists (RR, WR, and PK). During ERCP and following ES, a standard balloon sweeping or basket extraction or advanced technique to remove CBD stone was done if the cholangiogram revealed CBD stone.

Follow-up

After discharge, patients considered unfit for surgery were continued as outpatient status with only a follow-up visit in our medical clinic. On the other hand, asymptomatic patients with plans for deferred cholecystectomy were followed up at both medical clinic by gastroenterologists and at the surgical clinic by surgeons until interval cholecystectomy was performed. This index cholecystectomy was considered the endpoint. Recurrent attack was defined when a patient was readmitted due to ABP or other GCs i.e., acute cholecystitis, acute cholangitis, and Mirizzi syndrome [28] and was therefore, scheduled for the earliest available cholecystectomy.

Statistical analysis

To compare characteristics and clinical outcomes of the ERCP–ES patient group to the no ERCP group, Student's *t* test was performed for continuous variables and Chi square or Fisher's exact test was performed for categorical variables. Continuous variables are presented as the mean \pm standard deviation (SD) for normal distribution and as the median (range) for non-normal distribution. Categorical variables are reported as numbers and percentages. We defined recurrence rates as a time-to-event outcome using the Kaplan Meier method and compared the diseases free survival of the ERCP–ES group and the no ERCP group using a Log-Rank Test. A *p* value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 23 for Windows software (SPSS, Chicago, Ill., USA).

Results

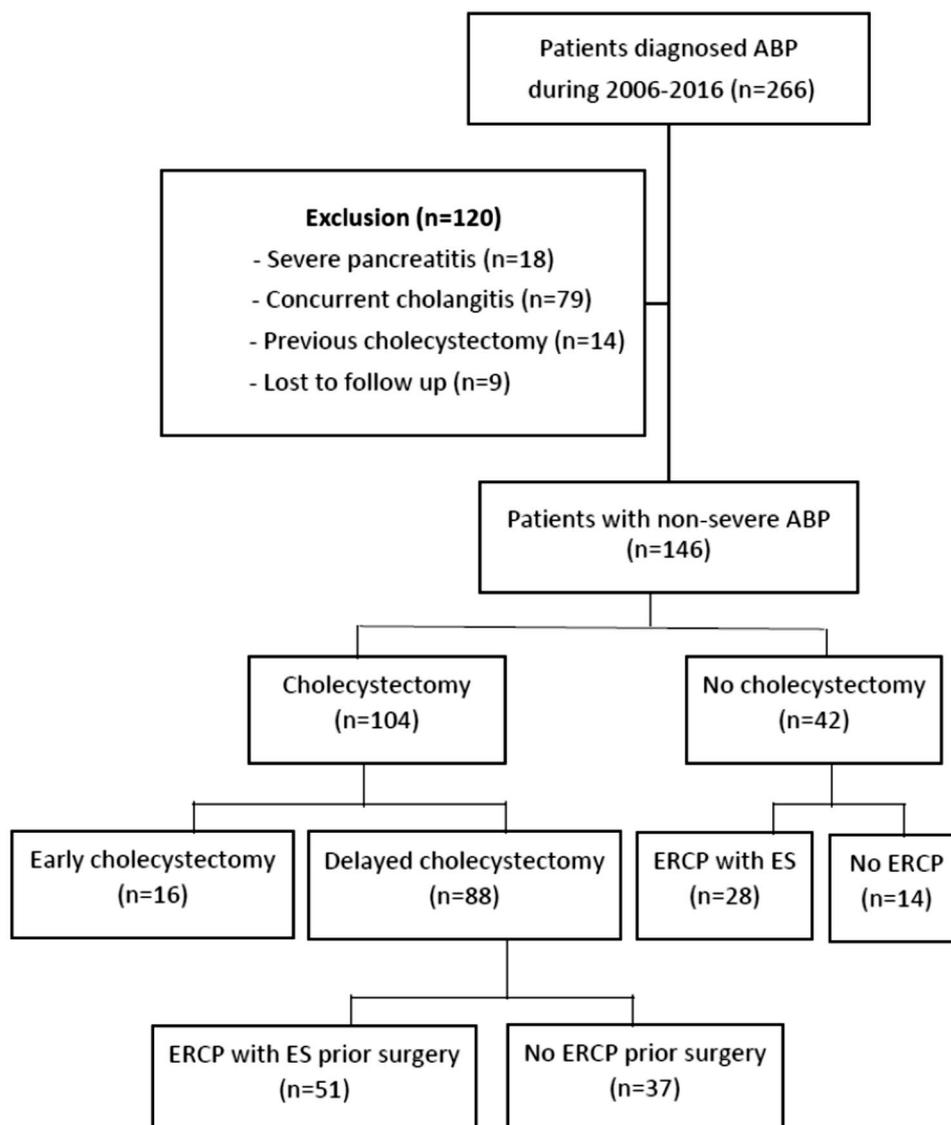
During the 11-year study period, we identified 266 patients who developed the first ABP and were hospitalized (Fig. 1). Patients with severe ABP ($n = 18$), concurrent cholangitis ($n = 79$) and previous cholecystectomy ($n = 14$) were excluded. Nine patients were lost to follow up after recovering from initial admission for ABP. Finally, 146 patients with non-severe ABP were included in this study. Cholecystectomy was not performed in 42 (29%) because they were high-risk candidates for surgery or due to patient refusal of surgery. Only 16 patients (11%) had an EC during the first admission without post-operative adverse events. Mainly, the surgical procedure for EC and DC was laparoscopic cholecystectomy (94%). Open cholecystectomy was performed in 6%. Of 146 patients, 79 patients underwent ERCP–ES; (1) ES was done per indication because CBD stone was seen in imaging studies ($n = 11$), (2) empiric ES was done for the evidence of passing stone with more stones left in the gallbladder ($n = 40$), and those who were deemed unfit for surgery for a long period of time or refusing surgery ($n = 28$).

Overall, including both patients who underwent DC and those who had gallbladder left in situ ($n = 130$), recurrent attacks of ABP occurred in 2 (3%) and 11 (22%) of patients in the ERCP–ES group ($n = 79$) and the no-ERCP group ($n = 51$), respectively ($p = 0.001$). Using the Kaplan Meier method, patients in the ERCP–ES group had lower risk of recurrent attacks of ABP during mean follow-up period of 1393 ± 182 (range 12–2288) days ($p = 0.01$) (Fig. 2).

In patients with non-severe ABP undergoing EC ($n = 16$), median time to cholecystectomy was 8 days (range 4–14 days). No patients developed recurrent pancreatitis, acute cholecystitis and ascending cholangitis during the short waiting period for cholecystectomy. The number of patients with acute cholecystitis while awaiting cholecystectomy in those undergoing EC, DC, and those without cholecystectomy were different but not statistically different (0% vs. 6% vs. 10%; $p = 0.39$) [between those undergoing EC vs. DC (0% vs. 6%; $p = 0.19$) and between those receiving EC vs. no cholecystectomy (0% vs. 10%; $p = 0.10$) and between those who underwent DC vs. patients with gallbladder left in situ (6% vs. 10%; $p = 0.29$)]. One patient in the ERCP–ES group who did not receive cholecystectomy died from gangrenous cholecystitis.

Of patients with non-severe ABP undergoing DC ($n = 88$), 51 (58%) patients underwent ERCP–ES prior to surgery whereas 37 (42%) patients did not have ERCP before DC. Patients' baseline characteristics were similar between the ERCP–ES and the no-ERCP groups, including

Fig. 1 Patient diagnosed with acute biliary pancreatitis during 2006–2016 ($n=266$)



age, gender, CCI, clinical status upon admission and laboratory findings (Table 1). Precut sphincterotomy was performed in two patients in the ERCP–ES group. Of those with ERCP–ES ($n=51$), eight patients (16%) were found to have CBD stones during balloon extraction; stone size ranged from 6 to 20 mm (mean CBD stone size 11 mm). In the remaining patients whose ERCP did not reveal CBD stone but had evidence of more stones in the gallbladder ($n=43$), CBD diameter ranged from 3 to 5 mm. Median time to ES was 3 days (range 1–6 days) (Table 2). Recurrent attacks of ABP in the ERCP–ES group were significantly less frequent than those in the no-ERCP group (2% vs. 17%; $p=0.01$). All recurrent episodes of ABP in both groups were with mild severity. Of six patients who did not have ES prior to surgery and developed recurrent attacks, three patients had two episodes of recurrent ABP while three patients developed only one episode while waiting

for DC. Median times to recurrent ABP were not significantly different between the ERCP–ES and the no-ERCP groups (21 vs. 127 days; $p=0.29$). Median times to subsequent cholecystectomy were not different between the two groups (68 vs. 93 days; $p=0.22$). One patient who developed acute cholecystitis had two episodes of the attack during the follow-up period. In the ERCP–ES group, adverse events related to ERCP occurred in 4 (8%), including worsening pancreatitis which resolved within 3 days ($n=2$; 4%) and post sphincterotomy bleeding requiring adrenaline injection ($n=2$; 4%). No ascending cholangitis was noted while waiting for DC.

In patients with non-severe ABP who did not undergo cholecystectomy ($n=42$), 28 (67%) patients underwent ERCP–ES, whereas 14 (33%) patients did not receive ERCP. In the ERCP–ES group of patients, precut sphincterotomy was performed in one patient. Baseline characteristics were

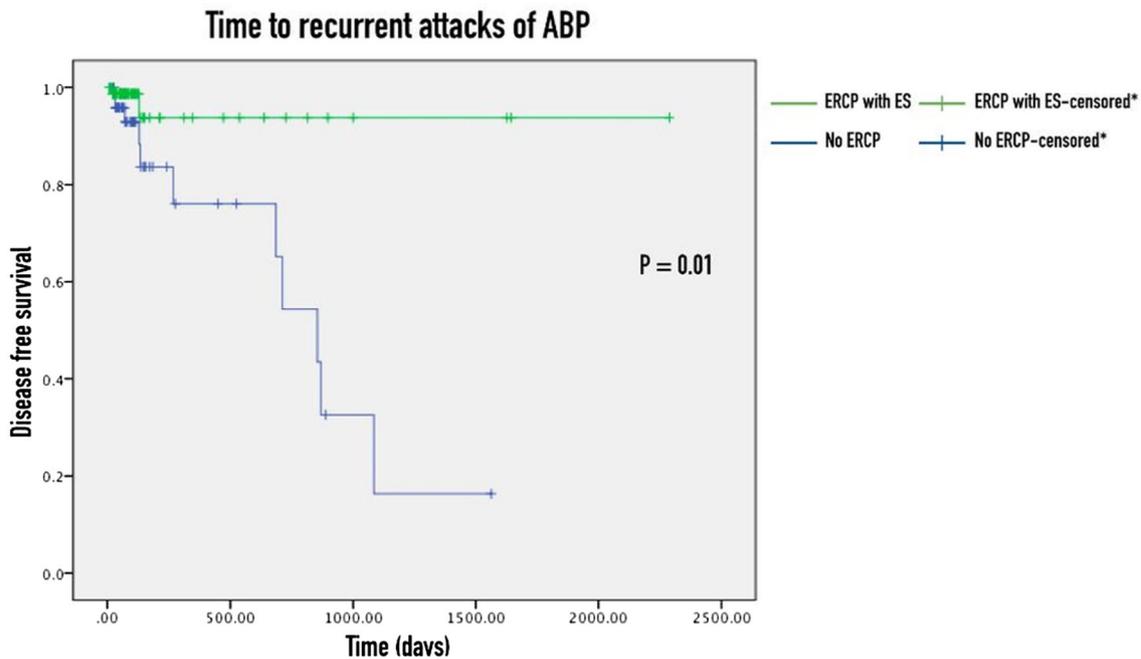


Fig. 2 Disease-free survival after first attacks of ABP comparing patients with and without endoscopic sphincterotomy during follow-up ($n = 130$). *Patients with either follow-up cholecystectomy or the last follow-up visit by the end of the study period

Table 1 Baseline characteristics of patients with acute biliary pancreatitis who underwent delayed cholecystectomy and did not undergo cholecystectomy ($n = 130$)

Characteristics	Delayed cholecystectomy ($n = 88$)			Without cholecystectomy ($n = 42$)		
	ERCP with ES ($n = 51$)	No ERCP ($n = 37$)	p value	ERCP with ES ($n = 28$)	No ERCP ($n = 14$)	p value
Age, mean (SD) (years)	59 (17)	54 (18)	0.20	63 (16.2)	66 (19)	0.64
Female, n (%)	31 (61)	22 (60)	0.90	16 (57)	9 (64)	0.66
Charlson Comorbidity Index, median (IQR)	2 (1–4)	2 (0–3)	0.41	3 (2–4)	3.5 (0–5)	0.45
Systemic inflammatory response syndrome (SIRS) upon admission, n (%)	21 (41)	19 (51)	0.34	10 (36)	10 (71)	0.03
Laboratory findings						
– AST, median (range) (U/L)	161 (18–1067)	145 (25–665)	0.42	252 (27–659)	110.5 (15–2429)	0.10
– ALT, median (range) (U/L)	168 (21–838)	160 (20–764)	0.49	195 (27–703)	102 (17–965)	0.06
– ALP, median (range) (U/L)	170 (66–844)	166 (37–1052)	0.22	209.5 (56–622)	135 (59–381)	0.09
– Total bilirubin, median (range) (mg/dL)	2.5 (0.5–17.2)	2.1 (0.5–7.5)	0.32	4.6 (1–14.5)	1.1 (0.3–5.9)	<0.001

not different between the ERCP–ES and the no-ERCP group, including age (63 vs. 66 years; $p = 0.64$), female (57% vs. 64%; $p = 0.66$), CCI (3 vs. 3.5; $p = 0.45$). However, the presence of SIRS upon admission in the ERCP–ES group was found to be less than those in the no-ERCP group (36% vs. 71%; $p = 0.03$). Median time to ERCP–ES was 3 days (range 1–6 days). Median follow-up times were not different between the two groups (117 vs. 172 days; $p = 0.47$). Similar to those who underwent DC, the recurrent rate of

ABP in the ERCP–ES group was significantly lower than the no-ERCP group (4% vs. 36%; $p = 0.006$). All recurrent episodes of ABP were with mild severity except one patient in the no-ERCP group who died from recurrent severe ABP. Of five patients who did not have ERCP–ES and developed recurrent attacks, three patients had two episodes of recurrent ABP and two patients had one episode during follow-up. Adverse events related to ERCP occurred in 3 (11%) patients, including worsening pancreatitis which resolved

Table 2 Outcomes of endoscopic sphincterotomy in patients with acute biliary pancreatitis who underwent delayed cholecystectomy and did not undergo cholecystectomy ($n = 130$)

Outcomes	Delayed cholecystectomy ($n = 88$)			Without cholecystectomy ($n = 42$)		
	ERCP with ES ($n = 51$)	No ERCP ($n = 37$)	p value	ERCP with ES ($n = 28$)	No ERCP ($n = 14$)	p value
Time to ERCP with ES, median (range) (days)	3 (1–6)	–		3 (1–6)	–	
The presence of common bile duct stone during balloon extraction, n (%)	8 (9)	–		3 (7)	–	
Time to subsequent cholecystectomy, median (range) (days)	68 (19–727)	93 (15–910)	0.22	–	–	
Recurrent ABP, n (%)	1 (2)	6 (17)	0.01	1 (4)	5 (36)	0.006
• Time to recurrence, median (range) (days)	21	127 (30–854)	0.29	129	686 (31–1085)	0.67
Acute cholecystitis, n (%)	4 (8)	1 (3)	0.28	3 (11)	1 (7)	0.65
• Time to attack, median (range) (days)	26 (8–636)	8	0.40	34 (30–103)	8	–
Ascending cholangitis	0	0	–	0	0	–
Follow-up time, median (days)	–	–		117 (20–2288)	172 (12–1982)	0.47

within 3 days after ERCP–ES ($n = 1$; 4%) and post sphincterotomy bleeding which stopped spontaneously ($n = 2$; 7%). The development of acute cholecystitis was not different between the ERCP–ES and the no-ERCP groups (11% vs. 7%; $p = 0.65$). No ascending cholangitis and Mirizzi syndrome were reported in patients who did not receive cholecystectomy.

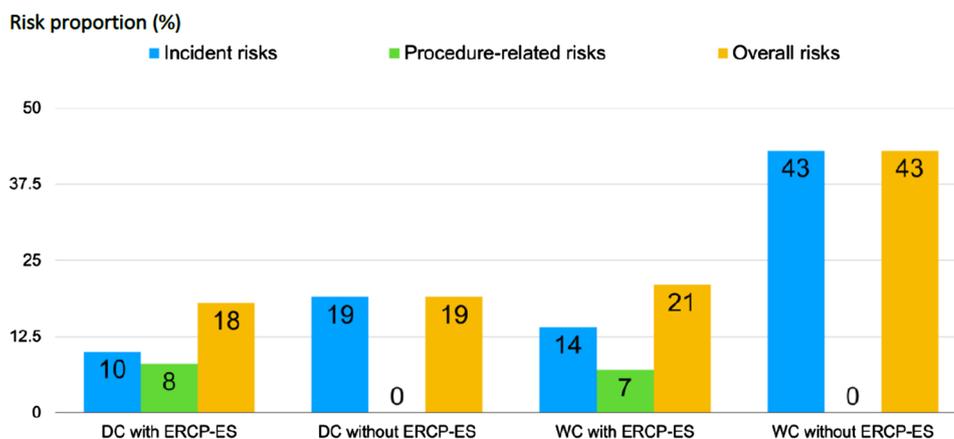
Overall risks were compared in each study group, including incident (recurrent ABP, acute cholecystitis, and acute cholangitis) and procedure-related risks (worsening pancreatitis and post sphincterotomy bleeding) (Fig. 3). Procedure-related risks were similar between patients undergoing DC and patients who did not received cholecystectomy (8% vs. 7%). In patients with non-severe ABP who did not received cholecystectomy ($n = 42$), patients without ERCP–ES developed twice overall risks (43% vs. 21%) and triple incident risks (43% vs. 14%) than those with ERCP–ES. In patients

with non-severe ABP who underwent DC ($n = 88$), overall risks were similar between patients with and without ERCP–ES group (18% vs. 19%); however, the no-ERCP–ES group had almost twice incident risks than the ERCP–ES group (19% vs. 10%).

Discussion

A few guidelines including the American College of Gastroenterology (ACG) and the British guidelines have suggested that ERCP with ES may prevent recurrent ABP in certain groups such as high-risk surgical candidate who cannot undergo an EC and those with severe ABP [3, 6, 19–23, 25, 29]. Previously, there were three large-scale studies, including the UK study [30], the Canada study [31] and the Dutch Pancreatitis Study Group [32], which investigated the

Fig. 3 The risks of incident and procedure-related outcomes of endoscopic sphincterotomy in patients with acute biliary pancreatitis who underwent delayed cholecystectomy and did not undergo cholecystectomy ($n = 130$). *DC delayed cholecystectomy, WC without cholecystectomy, ES endoscopic sphincterotomy



risk of recurrent biliary events after definitive treatment by cholecystectomy, ERCP–ES or both in patients with ABP. Although previous studies showed the benefit of ERCP–ES in preventing the risk of recurrent ABP [30–34], these data were limited by the study design, the heterogeneity of the study population with mixed severe and non-severe ABP, and various time to perform ERCP–ES, the lack of a control group, and more importantly in many studies, ES was not empirically offered to all who underwent ERCP. In our study, we performed ES in all patients with non-severe ABP who underwent ERCP. Regardless of the plan for cholecystectomy, our study demonstrated a lower incidence of recurrent ABP in non-severe ABP patients who underwent non-urgent ERCP with ES than those who did not have ERCP. Possible explanations for these results are that biliary sphincterotomy can relieve pressure on the pancreaticobiliary system and can facilitate future CBD stone passage [24]. The UK study only reported the number of ES but did not address the number of patients who underwent ERCP without ES [30]. Of nine studies included in the systemic review from the Dutch Pancreatitis Study Group, three studies reported no patients undergoing ERCP or ES while one study did not even mention about patients undergoing ERCP or ES [32]. In the Canada study, those who underwent ERCP–ES alone were older and had greater comorbidity than those who underwent cholecystectomy alone, leading to treatment-selection bias [31]. Nevertheless, their final conclusion still supported the benefit of ERCP–ES.

Similar to the UK (1.2% vs. 4.4%, $p < 0.0001$), the Canada (5.1% vs. 13.1%, $p < 0.0001$) and the Dutch Pancreatitis Study Group (1% vs. 9%, p value not available), our study demonstrated fewer recurrent biliary pancreatitis in patients who had ERCP–ES compared to those without ERCP–ES during the waiting period for interval cholecystectomy in patients with ABP (2% vs. 17%, $p = 0.01$) [30–32]. In our study, the rate of future attack of GCs in the ERCP–ES group was in keeping with NHS hospital records from the UK and the Dutch Pancreatitis Study Group (8% vs. 12.2% vs. 10%) [30, 32]. In the Dutch Pancreatitis Study Group, the results of other GCs included acute cholecystitis and biliary colic; however, those were not specifically detailed in the UK study. In our data, acute cholecystitis was more common in patients who did not receive cholecystectomy and who underwent DC than those who underwent EC (10% vs. 6% vs. 0%); however, the significant differences were not shown ($p = 0.39$). Nevertheless, we found no development of ascending cholangitis or Mirrizzi syndrome in those DC patients and those who did not have cholecystectomy. Based on these data, this would be the most practical strategy to offer patients with non-severe ABP when EC is not available. The risk of future GCs especially acute cholecystitis still needs to be kept in mind while waiting for DC. A recent retrospective cohort study by Elmunzer

et al. confirmed a significant and clinically important reduction in recurrent GCs (choledocholithiasis; OR 0.38, 95% CI 0.34–0.42, $p < 0.001$, ascending cholangitis; OR 0.28, 95% CI 0.23–0.34, $p < 0.001$, and gallstone pancreatitis; OR 0.35, 95% CI 0.24–0.49, $p < 0.001$) in older patients with serious comorbidities who underwent cholecystectomy after ERCP with ES compared to those undergoing ERCP–ES alone [28]. This study again demonstrated the comprehensive benefit to prevent GCs by providing the combination of cholecystectomy and ES. Our data can further emphasize specific advantages of ES to prevent recurrent ABP but does not prevent GCs such as cholecystitis. In our opinion, an interval cholecystectomy is strongly recommended in all surgical candidates.

Overall, we reported adverse events related to ERCP with empiric ES which was performed during the index admission, including worsening pancreatitis ($n = 3$; 4%) but fortunately the clinical improvement returned to normal within 3 days. We had four patients who developed post sphincterotomy bleeding (9%), none requiring additional intervention after the index ERCP whereas the large studies from UK and Canada failed to mention the safety of ERCP–ES and the adverse incidence was not reported [30, 31]. Based on our data, ERCP with empiric ES during index episode of ABP is safe to perform by an experienced endoscopist. With an acceptable procedure-related risk proportion, the incident risks of patients with non-severe ABP in the DC and the no-cholecystectomy group who receives ERCP–ES are lower than those without ERCP–ES (Fig. 3). Similar rates of adverse events related to ERCP–ES in the same setting and was successful in the same subject categories were reported as an abstract from the US. A prospective non-randomized trial by Kahaleh et al. compared the incidence of recurrent ABP after ES alone ($n = 96$) and after ES plus cholecystectomy ($n = 66$) in patients with gallstone pancreatitis. They found no difference in the recurrent rates of ABP (2.1% vs. 3%, $p = 0.28$) [35]. Following ERCP–ES, adverse events related to the procedure included 8 (3.5%) mild post ERCP pancreatitis, 5 (2.2%) post sphincterotomy bleeding, 1 (0.4%) duodenal hemorrhage, 1 (0.4%) biliary stent migration, and 1 (0.4%) bowel perforation requiring surgery. However, no patients died secondary to ERCP.

The limitations of our study were the retrospective nature of study design and the limited number of patients for subgroup analysis. The study is underpowered to demonstrate differences in certain outcomes between groups, e.g., cholecystitis. Although it was not statistically significant, our subgroup analysis showed the trend of benefit toward offering EC to prevent other GCs, especially acute cholecystitis, over those with DC and those with gallbladder left in situ. Despite this limitation, our study showed the benefits of ERCP with empiric ES that can usually be performed during index admission. In our study, the number of patients

in DC group was many more than the EC group; however, this reflects the real-life practice. Like many institutions, our situation as a tertiary referring center for patients with ABP that may require ERCP, the number of ERCP that we can perform is much higher than the operative theaters capacity that also have to support other types of operation apart from cholecystectomy. In fact, many patients were referred back to the primary hospitals for cholecystectomy (if they were capable to perform).

In conclusion, ERCP with empiric ES is safe and can reduce the risks of recurrent ABP in non-severe ABP patients; however, ES may not be adequate to prevent other GCs, especially acute cholecystitis. Therefore, EC is strongly recommended. DC as an interval cholecystectomy is an alternative in those who EC is not possible. Nevertheless, for high-risk surgical candidates and those refusing cholecystectomy, ERCP with empiric ES is still beneficial to prevent recurrent ABP.

Author contributions Conception and design (RR, WR), data collection (RR, SK, PP, PA, PK, WR), data analysis and interpretation (SK, PP, WR), manuscript drafting (SK, PP, WR), critical revision of the article for important intellectual content (RR, PA, PK, WR), final approval of the article (RR, SK, PP, PA, PK, WR).

Compliance with ethical standards

Disclosures Drs. Wiriyaoporn Ridthitid, Santi Kulpatcharapong, Panida Piyachaturawat, Phonthep Angsuwatcharakon, Pradermchai Kongkam, and Rungsun Rerknimitr have no conflicts of interest or financial ties to disclose.

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