Journal of Clinical and Translational Research
10.18053/Jctres/09.202303.007
ORIGINAL ARTICLE

Therapeutic outcomes of early and delayed ERCP and PTCD in patients with obstructive severe acute biliary pancreatitis

Xue Ling Zhang[1, 2†], Jia Huan Sun[1, 2†], Yue Wu[1, 2], Min Xie[1, 2], Cong Cong Li[1, 2], Dong Lv[2], Wei Yu[3]*, Pei Lin Cui[1, 2]*

1. Department of International Medical Services (IMS), Beijing Tiantan Hospital, Capital Medical University
2. Department of Gastroenterology, Beijing Tiantan Hospital, Capital Medical University
3. Department of General Surgery, Beijing Tiantan Hospital, Capital Medical University

†These authors contributed equally to this work

*Corresponding author
Wei Yu,
Department of General Surgery, Beijing Tiantan Hospital, Capital Medical University, Beijing 100070, China.
Email: yuweimade@sina.com

Pei Lin Cui,
Department of International Medical Services (IMS), Beijing Tiantan Hospital, Capital Medical University, Beijing 100070, China.
Email: cuipl@aliyun.com

Article information:
Received: August 24, 2022
Revised: Oct 24, 2022
Accepted: April 21, 2023

Journal of Clinical and Translational Research
10.18053/Jctres/09.202303.007

Abstract

Background: Obstructive severe acute biliary pancreatitis (SABP) is a clinical emergency with a high rate of mortality

that can be alleviated by endoscopic retrograde cholangiopancreatography (ERCP) and percutaneous tr anshepatic cholangial drainage (PTCD) selectively. However, the optimal timing of ERCP and PTCD r equires elucidation.

Aim: To evaluate outcome parameters in patients with SABP subjected to ERCP and PTCD compared to SABP patients who were not subjected to any form of invasive intervention.

Methods: A total of 62 patients with obstructive SABP who had been treated from July 2013 to July 2019 were included in this retrospective case-control study and stratified into a PTCD group (N = 22), ERCP group (N = 24), and conservative treatment group (N = 16, control). Patients in the PTCD and ERCP groups were substratified into early (≤ 72 h) and delayed (> 72 h) treatment groups based on the timing of the intervention after diagnosis. Clinical chemistry, hospitalization days, liver function, abdominal pain, and complications were determined to assess treatment efficacy and safety of each modality and to establish the optimal timing for PTCD and ERCP.

Results: The average hospitalization time, time to abdominal pain relief, and time to normalization of hematological and clinical chemistry parameters (leukocyte count, amylase, ALT, and total bilirubin) were shorter in the PTCD and ERCP group compared to the conservative treatment group ($p < 0.05$). The average hospitalization time in the ERCP group (16.7 ± 4.0 d) was shorter compared to the PTCD group (19.6 ± 4.3 d) ($p < 0.05$). Compared to the conservative treatment group (62.5%), there were more complications in patients treated with ERCP and PTCD ($p < 0.05$). In the early ERCP group, the average hospitalization time (13.9 ± 3.3 d) and the time to normalization of leukocyte count (6.3 ± 0.9

d) and total bilirubin (9.1 ± 2.0 d) were lower than in the delayed ERCP group (18.6 ± 4.1 d, 9.9 ± 2.4 d, 11.8 ± 2.9 d, respectively) and early PTCD group (16.4 ± 3.7 d, 8.5 ± 2.1 d, 10.9 ± 3.1 d, respectively) ($p < 0.05$). In the delayed ERCP group, the average hospitalization time (18.6 ± 4.1 d) and ALT recovery time (12.2 ± 2.6 d) were lower than in the delayed PTCD group (21.9 ± 4.3 d and 14.9 ± 3.9 d, respectively) ($p < 0.05$).

Conclusions: ERCP and PTCD effectively relieve SABP-associated biliary obstruction with comparable overall incidence of complications. It is recommended that ERCP is performed within 72 h after diagnosis; and PTCD drainage may be considered as an alternative approach in cases where patients are unable or unwilling to undergo ERCP or ERCP is unsuccessful.

Relevance for patients: ERCP and PTCD in patients with obstructive SABP can resolve biliary obstruction and delay progression of the disease. Performing ERCP and PTCD within 72 h (i.e., optimal treatment time window) can be beneficial to patients, especially in terms of post-operative recovery. Visual biliary endoscopy (oral or percutaneous transhepatic) may be used for concomitant therapeutic interventions in the biliary system.

Keywords: severe biliary pancreatitis; liver function; obstructive; percutaneous transhepatic cholangial drainage; endoscopic retrograde cholangiopancreatography

Journal of Clinical and Translational Research
10.18053/Jctres/09.202303.007

List of abbreviations

ABP, acute biliary pancreatitis; ALT, alanine transaminase; ENBD, endoscopic nasobiliary drainage; ERCP, endoscopic retrograde cholangiopancreatography; ES, endoscopic sphincterotomy; EST, endoscopic sphincterotomy; MABP, mild acute biliary pancreatitis; MODS, multiple organ dysfunction syndrome; POF, persistent organ failure; PTCD, percutaneous transhepatic cholangial drainage; SABP, severe acute biliary pancreatitis; SIRS, systemic inflammation response syndrome; TBiL, total bilirubin

1. Introduction

Acute pancreatitis (AP) is a common clinical emergency associated with high morbidity and mortality [1]. In the past few years, the incidence of first-time acute pancreatitis and disease-related complications has been rising [2]. Acute biliary pancreatitis (ABP) accounts for 50%-70% of the acute pancreatitis cases [3]. The etiology of ABP is complex and multifactorial. Several risk factors have been reported, of which gallstones are the predominant cause of acute pancreatitis [4,5]. About 20% of acute pancreatitis patients exhibit episodes of severe acute pancreatitis. Severe acute pancreatitis is characterized by persistent single or multiple organ failure, which is associated with mortality rates ranging between 20% and 40% [6-9]. According to the Determinant-Based Classification (DBC) [10] and Revised Atlanta Classification (RAC) [7], severe acute pancreatitis entails the manifestation of local or systemic complications, as well as persistent organ failure (POF; > 48 h) affecting the cardiovascular-, respiratory-, and renal system.

Whereas early management of different degrees and causes of pancreatitis predominantly encompasses fluid resuscitation, alleviation of biliary obstruction is advocated for obstructive severe acute biliary pancreatitis (SABP) [11]. SABP is defined as persistent single or multiple organ failure (> 48 h) according to RAC, with the cause of severe pancreatitis being biliary obstruction as confirmed by imaging.

Biliary obstruction can be removed via endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangial drainage (PTCD), or surgical intervention. ERCP is the primary option for ABP patients with acute cholangitis [12]. However, the 2013 IAP/APA guidelines [13] suggest that there is no evidence for an optimal timing of ERCP in biliary pancreatitis patients who do not present with cholangitis. With respect to the timing of ERCP, the 2015 Italian consensus guidelines [14,15] on

severe acute pancreatitis recommend that ERCP should be performed within 72 h of admission after confirmation of biliary obstruction. According to the 2019 ASGE guidelines [16] on the role of endoscopy in the evaluation and management of choledocholithiasis, patients with biliary pancreatitis with concurrent biliary obstruction or bile duct stones are recommended to undergo emergency ERCP within 48 h. The JPN clinical practice guidelines for the management of acute pancreatitis [17] state that early ERCP/endoscopic sphincterotomy (EST) significantly reduce the case fatality rate and the rates of complications associated with pancreatitis or cholangitis and organ failure/sepsis more effectively than elective ERCP/EST (after 72 h).

PTCD is widely accepted as an alternative to operative decompression in patients with cholangitis or cholecystitis, particularly in elderly patients [18-20] and SABP patients who do not tolerate endoscopy [21] or are unsuitable for endoscopy [22]. A retrospective study [23] involving 64 patients with obstructive SABP revealed that early PTCD reduced laboratory indicators and APACHE-II scores.

To what extent ERCP and PTCD can improve clinical parameters such as laboratory indices, duration of hospitalization, recovery of liver function, and remission of abdominal pain and complications is currently not well characterized. Furthermore, the optimal timing of ERCP and PTCD as a treatment option for patients with obstructive SABP requires elucidation. Accordingly, the effectiveness of both modalities as early treatment of obstructive SABP warrants investigation. This study therefore retrospectively analyzed the clinical data of patients with obstructive SABP to evaluate the clinical outcomes of PTCD and ERCP and to determine the optimal timing of each intervention.

2. Materials and methods

2.1 Patients and data collection

Patients from Beijing Tiantan Hospital who met the inclusion criteria (Table 1) were included in this retrospective case-control study. The institutional research ethics committee of Beijing Tiantan Hospital, Capital Medical University approved this study under protocol number KY2020-032-02. Clinical data of 62 patients with obstructive SABP who were admitted to Beijing Tiantan Hospital between July 2013 and July 2019 were analyzed. The patients were categorized into the conservative treatment group (N = 16), the PTCD group (N = 22), and the ERCP group (N = 24). Patients in the PTCD and ERCP group were further divided into an early PTCD or ERCP group (intervention performed within 72 h after diagnosis, N = 10 and N = 8, respectively) and a delayed PTCD or ERCP group (intervention performed > 72 h after diagnosis, N = 12 and N = 16, respectively). Patients with SABP who presented with cholangitis or bile duct obstruction [24] and had undergone ERCP were included in the ERCP group. Patients who could not tolerate endoscopy due to advanced age, persistent organ failure, comorbidities, and clinical deterioration with signs or strong suspicion of infected necrotizing pancreatitis were included in the PTCD group. Patients who could not tolerate PTCD and ERCP/endoscopic nasobiliary drainage (ENBD) as well as those who refused to accept any form of invasive intervention were included in the conservative treatment group. Notably, in cases where previously scheduled treatments had failed or in cases with critical conditions, emergency interventions or surgical treatment were recommended after obtaining written informed consent [25,26]. A total of 62 SABP patients were included in this study (Table 1, Figure 1).

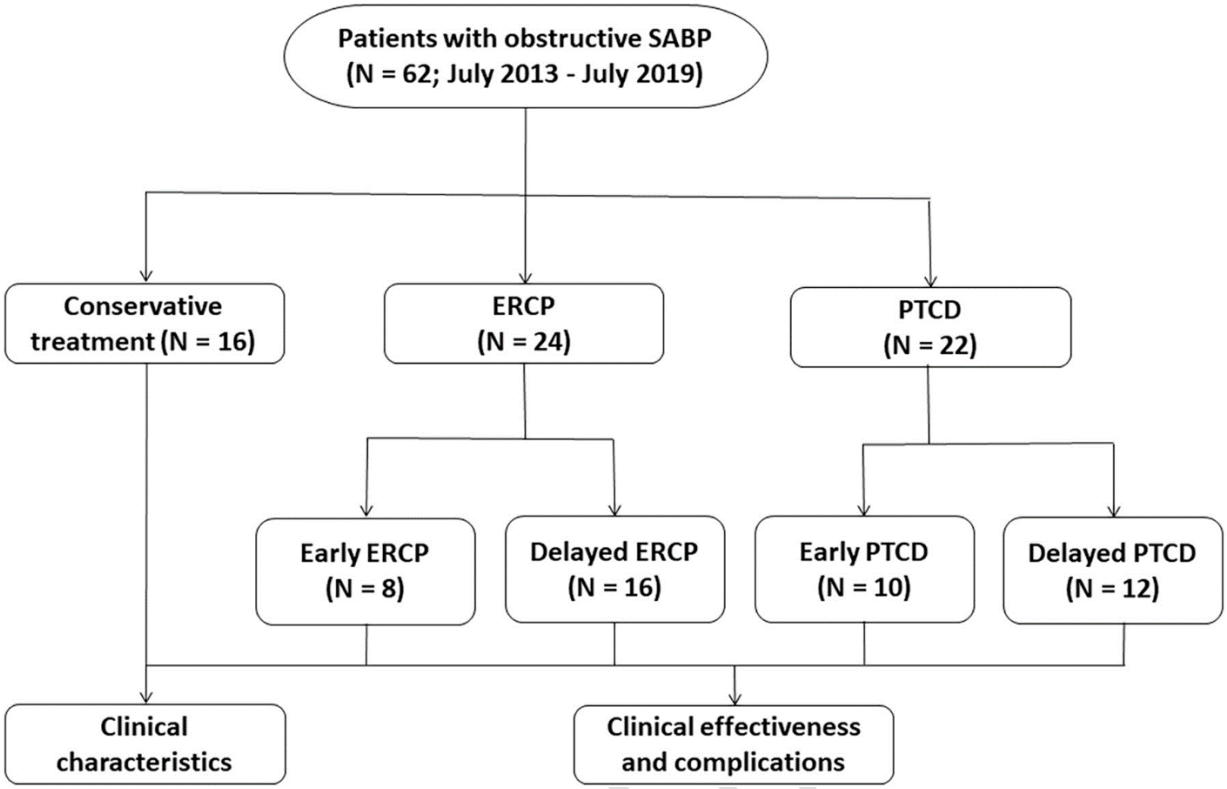

Figure 1. Flow chart of the study setup.

2.2 Treatment procedures

2.2.1 Conservative treatment

All patients in the conservative treatment group did not undergo ERCP or PTCD following admission, but only received conservative treatment that included fasting (both solids and liquids), liquid resuscitation, maintenance of electrolyte and acid-base balance, inhibition of pancreatic enzyme activity and pancreatic secretion, administration of proton pump inhibitors for gastric acid suppression, anti-inflammatory medication if necessary, and nutritional support.

2.2.2 Endoscopic retrograde cholangiopancreatography

In the ERCP group, patients underwent ERCP either within 72 h or 72 h after admission. After completion of preoperative anamnesis and routine assessments, ERCP was performed in a left-lateral position under antispasmodic medication (anisodamine i.m., 10 mg) and sedation with (pethidine i.v., 50 mg). Endoscopy was performed through the esophagus, stomach, and the descendant duodenum, after which the endoscopists adjusted the body angle to expose the duodenal papilla. Next, retrograde bile duct intubation was performed, followed by slow injection of iodinated contrast solution to determine whether the biliary tract contained stones or exhibited stenosis or parapapillary diverticulum. In case of choledocholithiasis, patients received additional interventions in the form of endoscopic sphincterotomy (ES), biliary lithotomy, and ENBD.

2.2.3 Percutaneous transhepatic cholangial drainage

Preoperative examinations for PTCD were similar to those for ERCP. Abdominal ultrasound was performed before the operation to ascertain the biliary or gallbladder puncture path and to locate the puncture point [27]. After intramuscular administration of 50 mg pethidine, routine disinfection, and local infiltration, anesthesia was administered. PTCD was performed under ultrasound guidance using an 18G puncture needle to gain access to the biliary system. Bile was extracted after the needle was removed to confirm proper placement. Subsequently, a guide wire was inserted through the needle. Using a subcutaneous catheter to dilate the puncture path, an 8F pigtail drainage tube was inserted and the wire was retracted [28,29]. The drainage tube was firmly secured to the skin and a sterile drainage bag was externally attached.

2.3 Clinical characteristics

The following clinical parameters were retrieved from the patient database: recovery time for leukocytes, blood amylase and alanine transaminase (ALT); duration of hospitalization, time to abdominal pain relief, discharge and recovery, and occurrence of complications. Complications that were assessed included acute accumulation of necrotic material, pancreatic pseudocyst, paralytic ileus, upper gastrointestinal hemorrhage, respiratory failure, systemic inflammatory response syndrome (SIRS), abdominal infection, sepsis, and post-ERCP pancreatitis [15].

2.4. Statistical analysis

Normally distributed continuous variables are expressed as mean ± standard deviation. Enumerative data were expressed as rates or constituent ratios. Intergroup differences between continuous variables were compared using an independent samples *t*-test or analysis of variance (ANOVA). Intergroup differences between categorical variables were compared with the χ^2-test and Fisher's exact test. A *p*-value of ≤ 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software (IBM, Armonk, NY, USA).

3. Results

3.1 Clinical characteristics of the cohort

The demographics and medical information of the 62 patients with acute obstructive biliary pancreatitis are listed in Table 2. The majority of patients was female (55%). The average age of the patients was 64 years.

ALT levels were more than three times the upper limit of the normal range, whereas total bilirubin (TBiL) levels were around double the upper limit of normal range. The APACHE-II score in the conservative treatment-, ERCP-, and PTCD group was 16.1 ± 5.0, 14.8 ± 4.2, and 15.3 ± 4.6 ($p > 0.05$), respectively, while the Ranson score was 4.6 ± 0.8, 4.5 ± 1.1, and 4.4 ± 1.3 ($p > 0.05$), respectively. Differences in comorbidities such as prior incidence of acute pancreatitis, cholelithiasis, heart disease, hypertension, diabetes, and MCTSI scores were not significant.

3.2 Outcomes and complications

The intervention effectiveness, recovery rate, and complications in the three groups as well as clinical indices in the early and delayed groups are presented in Tables 3, 4 and 5. The average length of hospitalization for the conservative treatment-, ERCP-, and PTCD group was 28.4 ± 4.5, 16.7 ± 4.0, and 19.6 ± 4.3 d, respectively. Abdominal pain relief time, leukocyte remission time, and the normalization time of blood amylase, ALT, and TBiL were shorter in the ERCP and PTCD group compared to the conservative treatment group ($p < 0.05$). The recovery rate of the conservative treatment group was lowest (62.5%) versus the ERCP (75.0%) and PTCD group (86.4%). Complications such as pancreatic pseudocyst, acute accumulation of necrotic material, and sepsis were lower in the ERCP and PTCD group relative to the conservative treatment group. Furthermore, the incidence of complications

in the PTCD group significantly differed from those in the conservative treatment group. Conservatively treated patients exhibited a higher incidence of acute accumulation of necrotic material, pancreatic pseudocyst, and sepsis. There were no deaths in any of the groups.

The average length of stay (13.9 ± 3.3 d), leukocyte count normalization (6.3 ± 0.9 d) and TBiL normalization (9.1 ± 2.0 d) in the early ERCP group were shorter than in the delayed ERCP and early PTCD groups ($p < 0.05$). The average hospitalization time (16.4 ± 3.7 d), time to abdominal pain relief (6.8 ± 2.7 d), leukocyte normalization (8.5 ± 2.1 d), blood amylase normalization (6.1 ± 1.7 d), TBiL normalization (10.1 ± 3.2 d), and ALT normalization (10.9 ± 3.1 d) in the early PTCD group were shorter compared to the delayed PTCD group ($p < 0.05$). The hospitalization time (18.6 ± 4.1 d) and ALT normalization (12.3 ± 2.6 d) in the delayed ERCP group were shorter than in the delayed PTCD group (21.9 ± 4.3 d and 14.9 ± 3.9 d, respectively) ($p < 0.05$).

Intubation failed in 2 cases in the ERCP group and succeeded in all instances in the PTCD group. Complications occurred in 8 cases after ERCP, including 1 case of pancreatitis and 4 cases of hyperamylasemia that showed improvement following conservative treatment. Two cases of post-ERCP cholangitis were remediated with third-generation cephalosporin and one case of pulmonary embolism after ERCP was resolved after anticoagulation. Complications occurred in 6 cases after PTCD, and the drainage tube was blocked in 3 cases, which was resolved by re-catheterization after adjusting the position or following extubation. One case of abdominal infection improved after antibiotics treatment. The skin at the puncture site of 2 patients became suppurative and improved after disinfection and dressing change.

Table 1. Summary of inclusion and exclusion criteria.

Criteria	Concomitant conditions or characteristics
Inclusion criteria	● Acute pancreatitis [30] ● Biliary cause of pancreatitis accompanied by POF (> 48 h) (organ failure was defined using the modified Marshall scoring system) [31]; APACHE-II score of ≥ 8; ≥ 3 for Ranson; and ≥ 8 for MCTSI [15] ● Meet the determination criteria for biliary tract obstruction: **i**. continuous increase in total bilirubin and direct bilirubin levels; **ii**. imaging (abdominal ultrasound, CT, MRCP, or EUS before ERCP and PTCD) suggesting biliary duct stones or common bile duct diameter ≥ 1.0 cm; **iii**. no obvious bile is introduced in gastrointestinal decompression
Exclusion criteria	● MABP (no evidence of organ dysfunction and without local and systemic complications; APACHE-II score < 8; < 3 for Ranson, and < 4 for MCTSI) ● Comorbidity ● Pregnancy or puerperium ● Insufficient clinical data

Table 2. Demographics and medical data for obstructive SABP patients in the conservative-, ERCP-, and PTCD treatment group.

Clinical data	Conservative treatment (N = 16)	ERCP (N = 24)	PTCD (N = 22)	F/c^2	*p*-value
Age (years)	62.8 ± 18.4	65.3 ± 16.5	64.2 ± 17.2	0.096	0.908
Gender [N (%)]					
Male	8 (50.0)	11 (45.8)	9 (40.9)	0.316	0.854
Female	8 (50.0)	13 (54.2)	13 (59.1)	0.316	0.854
WBC ($\times 10^9$/L)	15.3 ± 3.2	16.4 ± 4.0	16.3 ± 4.1	0.448	0.641
BUN	5.9 ± 2.0	6.1 ± 1.3	6.8 ± 2.1	0.496	0.615
LDH	358 ± 158	381 ± 150	308 ± 138	0.481	0.624
Serum Ca	2.0 ± 0.1	2.1 ± 0.1	2.1 ± 0.2	2.014	0.148
Blood amylase (U/L)	1242 ± 422	1286 ± 327	1210 ± 279	0.296	0.745
Urine amylase (U/L)	3861 ± 1284	3769 ± 1403	3871 ± 1284	0.165	0.849
ALT (U/L)	260 ± 115	254 ± 102	249 ± 20	0.054	0.947
TBiL (μmol/L)	42 ± 13	44 ± 13	43 ± 15	0.120	0.887
Comorbidities [N (%)]					
Prior incidence of acute pancreatitis	3 (18.8)	4 (16.7)	3 (13.6)		0.913
Cholelithiasis	3 (18.8)	9 (37.5)	7 (31.8)		0.505
Heart disease	5 (31.3)	4 (16.7)	4 (18.2)		0.533
Hypertension	8 (50.5)	9 (37.5)	6 (27.3)	2.053	0.358
Diabetes	2 (12.5)	5 (20.8)	4 (18.2)		0.914
APACHE-II score	16 ± 5	15 ± 4	15 ± 5	0.352	0.705
Ranson score	4.6 ± 0.8	4.5 ± 1.1	4.4 ± 1.3	0.174	0.840
MCTSI score	7.2 ± 0.8	6.9 ± 0.8	6.9 ± 0.8	0.731	0.486

Table 3. Clinical outcome parameters in the conservative-, ERCP-, and PTCD treatment group.

Parameter	Conservative treatment	ERCP	PTCD
Hospitalization time (d)	28.4 ± 4.5	16.7 ± 4.0* #	19.6 ± 4.3*
Abdominal pain relief time (d)	11.9 ± 2.3	8.2 ± 4.2*	8.3 ± 2.9*
Leukocyte normalization time (d)	14.6 ± 3.9	8.9 ± 3.7*	9.3 ± 2.6*
Blood amylase recovery time (d)	12.8 ± 2.4	7.4 ± 3.7*	7.7 ± 2.3*
ALT recovery time (d)	19.4 ± 4.0	11.8 ± 3.4*	12.9 ± 3.9*
TBiL recovery time (d)	17.6 ± 3.9	10.9 ± 2.9*	12.6 ± 3.8*

* ERCP and PTCD group compared to conservative treatment group ($p < 0.05$)

ERCP group compared to the PTCD group ($p < 0.05$)

Table 4. Recovery rate and complications in the conservative treatment-, ERCP-, and PTCD group.

Parameter	Conservative treatment (N = 16)	ERCP (N = 24)	PTCD (N = 22)
Automatic discharge [N (%)]	2 (12.5)	2 (8.3)	1 (4.6)
Recovery cases [N (%)]	10 (62.5)	18 (75.0)	19 (86.4)
Complications [N (%)]	10 (62.5)	8 (33.3)	6 (27.3)*
Acute accumulation of necrotic material (N)	5	3	3
Pancreatic pseudocyst (N)	1	0	0
Paralytic ileus (N)	2	1	1
Upper gastrointestinal hemorrhage (N)	1	0	1
Respiratory failure (N)	3	3	2
Systemic inflammatory response syndrome (N)	8	8	6
Abdominal infection (N)	2	0	1
Sepsis (N)	2	0	0
Cholangitis post-ERCP (N)	0	1	0

* PTCD group compared to the conservative treatment group ($p < 0.05$)

Table 5. Clinical outcomes and complications in the early and delayed ERCP and PTCD group.

Parameter	Early ERCP (N = 8)	Delayed ERCP (N = 16)	Early PTCD (N = 10)	Delayed PTCD (N = 12)
Hospitalization time (d)	13.9 ± 3.3* ^	18.6 ± 4.1^{+}	16.4 ± 3.7$^{\#}$	21.9 ± 4.3
Abdominal pain relief time (d)	5.6 ± 2.4	8.2 ± 3.1	6.8 ± 2.7$^{\#}$	10.5 ± 4.2
Leukocyte normalization (d)	6.3 ± 0.9* ^	9.9 ± 2.4	8.5 ± 2.1$^{\#}$	11.1 ± 4.1
Blood amylase recovery time (d)	5.5 ± 1.3*	8.9 ± 1.9	6.1 ± 1.7$^{\#}$	10.1 ± 4.0
ALT recovery time (d)	9.6 ± 2.6	12.3 ± 2.6^{+}	10.1 ± 3.2$^{\#}$	14.9 ± 3.9
TBiL recovery time (d)	9.1 ± 2.0* ^	11.8 ± 2.9	10.9 ± 3.1$^{\#}$	14.1 ± 3.7
Complications [n (%)]	3 (37.5)	5 (31.3)	3 (30.0)	3 (25.0)

* Early ERCP group *vs* delayed ERCP group ($p < 0.05$)
$^{\#}$ Early PTCD group *vs* delayed PTCD group ($p < 0.05$)
^ Early ERCP group *vs* early PTCD group ($p < 0.05$)
$^{+}$ Delayed ERCP group *vs* delayed PTCD group ($p < 0.05$)

4. Discussion

Acute biliary pancreatitis is a common health care challenge [32] that is predominantly caused by gallstones obstructing the biliopancreatic duct. Persistence obstruction of the ampulla can theoretically aggravate pancreatic inflammation and induce activation of cytokines involved in SIRS, pancreatic tissue inflammation, edema, and necrosis [33,34]. Consequently, obstructive SABP is a clinical emergency with high mortality rates (~15%) [35] and therefore requires prompt diagnosis and timely

intervention to reduce morbidity and deter mortality or recurrence. Studies [23,36] have shown that relieving biliary obstruction is an important measure to reduce SABP risk, delay disease progression, and improve prognosis.

Biliary obstruction can be alleviated by ERCP, PTCD, and laparoscopic surgery [37]. Although there is no universally accepted treatment approach for SABP, the step-up approach using endoscopic or percutaneous drainage has been demonstrated to produce superior outcomes [38]. First, a review of measures used for the management of acute biliary pancreatitis [39] revealed that angiocholitis necessitates ERCP with emergency endoscopic sphincterotomy in the event of acute pancreatitis. A meta-analysis [23] involving 519 patients with pancreatitis and biliary obstruction found that routine implementation of ERCP reduced local complications. Second, PTCD is a minimally invasive surgical method with high patient acceptance. PTCD is frequently utilized as an alternative method for surgical decompression to alleviate bile duct pressure in critically ill patients. This approach is particularly beneficial for patients with obstructive SABP who may be at a heightened risk while waiting for another endoscopic procedure. In such cases, PTCD should be considered as a viable option for providing prompt relief of the obstruction. This technique is known to be both safe and effective in the management of severe acute pancreatitis patients. Careful consideration and consultation with a qualified medical professional are advised to determine the best course of action for each individual patient. The 2016 Canadian Clinical Practice Guidelines for pancreatitis [40] recommended that PTCD should be considered for patients with severe acute pancreatitis complicated by bile duct obstruction or cholangitis when ERCP is not safe and feasible. According to previous studies and guidelines, we believe that PTCD can be applied early in patients with obstructive severe acute pancreatitis to relieve biliary pressure, drain bile, and help patients survive the acute phase. However, it has been reported that the incidence of

adverse events of PTCD is 3-30% [41], mainly owing to drainage tube blockage or dislocation, biliary peritonitis, and biliary reflex, among others. Most importantly, the underlying cause of obstruction caused by stones is not resolved. Nevertheless, PTCD is minimally invasive compared to the open surgical procedure. External drainage under ultrasound or CT guidance can be performed if endoscopic drainage is not feasible or available.

Presently, the diagnosis and treatment of obstructive ABP tend to be based on minimally invasive approaches. ERCP and PTCD have their own advantages and disadvantages. However, few studies have compared the effects of different treatment methods in terms of early or delayed PTCD for severe biliary pancreatitis. In this study, we conducted a face-to-face comparative analysis of minimally invasive interventions for severe pancreatitis and assessed the importance of treatment timing with the aim to further improve the clinical management of this disease. The clinical effectiveness of ERCP and PTCD for obstructive SABP was found to be comparable and both approaches were beneficial for the recovery of various laboratory indicators. Patients subjected to ERCP or PTCD had faster abdominal pain remission, shorter hospital stay, and lower incidence of sepsis. The number of complications following ERCP and PTCD were fewer than those experienced after conservative treatment. Our findings were consistent with previous studies [22,23,35].

For gallstone-induced pancreatitis patients with suspected ascending cholangitis, prompt ERCP is recommended. Given that there is no consensus on guidelines for obstruction relief during SABP and that emergency ERCP may not always be performed in clinical practice, we evaluated the therapeutic effects of early (≤ 72 h) versus delayed (> 72 h) ERCP and PTCD in ABP patients with cholangitis. The clinical effectiveness of early ERCP and PTCD was greater compared to delayed ERCP and PTCD. Correspondingly, endoscopic and interventional therapy within 72 h after admission is recommended

for relieving obstruction in patients with obstructive SABP.

SABP should be managed by intensive monitoring and systemic support. Conservative treatment is aimed at achieving supportive therapy, resuscitation, and addressing specific complications that may occur [42,43], making this treatment imperative and fundamental for SABP patients. Nonetheless, this study revealed that the clinical effectiveness and treatment satisfaction of patients subjected to conservative treatment alone were poor. In fact, three patients in the conservative group were eventually treated with ERCP since conservative treatment was not feasible or satisfactory. Due to the critical condition associated with obstructive SABP, clinicians may be concerned about administering conservative treatment without biliary obstruction relief. Although conservative therapy constitutes the basis of obstructive SABP, we have demonstrated that timely intervention (within 72 h) is justified by the reduced laboratory indices, shortened hospitalization time, expedited recovery of the liver, expedited remission of abdominal pain, and reduced complications. ERCP is initially advocated over PTCD because, firstly and in case of obstructive acute pancreatitis caused by common bile duct stones, ERCP can remove the stones through the duodenal papilla, reducing jaundice while removing the cause. Secondly, ERCP is less invasive than PTCD, which minimizes the risk of complications such as liver injury and bleeding compared to PTCD. If necessary, biliary drainage can be repeated without significantly increasing trauma. Thirdly, ERCP allows indirect observation and histological examination (biopsy) of the duodenal papilla. If early ERCP is deemed too risky or unfeasible, PTCD should be performed.

This study has some limitations. The sample size was limited and the cohort was derived from a single center and retrospectively analyzed. Another area of improvement is preoperative assessment of surgical risks, which requires a high level of expertise and a long learning curve. This is important

because failure to properly gauge these risks may lead to variation in the success rate of the procedures, subsequent cure rates, and postoperative complications, among other aspects. Given these limitations, stricter standardization, follow-up visits, high-quality care, and a larger cohort size are required to further finetune the strategies for the treatment and management of SABP.

Conclusions

Both ERCP and PTCD can effectively relieve biliary obstruction during SABP, with a comparable incidence of complications. Removal of biliary obstruction during SABP improves the clinical trajectory of the patient. Proper timing of the intervention is also crucial for reducing (post-intervention) complications. It is recommended that ERCP is performed within 72 h to alleviate obstruction. In cases where patients are unable or unwilling to undergo ERCP, or when ERCP is unsuccessful, PTCD drainage may be considered as an alternative approach.

Acknowledgments

We are grateful to the patients whose data were used in this manuscript.

This study was funded by the Digestive Medical Coordinated Development Center of Beijing Hospitals Authority (No. XXT14).

Conflict of interest

The authors declare no conflict of interest

References

1 James TW, Crockett SD. Management of acute pancreatitis in the first 72 hours. Curr Opin Gastroenterol 2018;34:330-335.

2 Oskarsson V, Hosseini S, Discacciati A, Videhult P, Jans A, Ekbom A, Sadr-Azodi O. Rising incidence of acute pancreatitis in sweden: National estimates and trends between 1990 and 2013. United European Gastroenterol J 2020;8:472-480.

3 Wang GJ, Gao CF, Wei D, Wang C, Ding SQ. Acute pancreatitis: Etiology and common pathogenesis. World J Gastroenterol 2009;15:1427-1430.

4 van Geenen EJ, van der Peet DL, Bhagirath P, Mulder CJ, Bruno MJ. Etiology and diagnosis of acute biliary pancreatitis. Nat Rev Gastroenterol Hepatol 2010;7:495-502.

5 Lightner AM, Kirkwood KS. Pathophysiology of gallstone pancreatitis. Front Biosci 2001;6:E66-76.

6 Banks PA, Freeman ML. Practice guidelines in acute pancreatitis. Am J Gastroenterol 2006;101:2379-2400.

7 Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, Tsiotos GG, Vege SS. Classification of acute pancreatitis--2012: Revision of the atlanta classification and definitions by international consensus. Gut 2013;62:102-111.

8 Schepers NJ, Bakker OJ, Besselink MG, Ahmed Ali U, Bollen TL, Gooszen HG, van Santvoort HC, Bruno MJ. Impact of characteristics of organ failure and infected necrosis on mortality in necrotising pancreatitis. Gut 2019;68:1044-1051.

9 Bang JY, Wilcox CM, Arnoletti JP, Varadarajulu S. Superiority of endoscopic interventions over minimally invasive surgery for infected necrotizing pancreatitis: Meta-analysis of randomized trials. Dig Endosc 2020;32:298-308.

10 Dellinger EP, Forsmark CE, Layer P, Lévy P, Maraví-Poma E, Petrov MS, Shimosegawa T, Siriwardena AK, Uomo G, Whitcomb DC, Windsor JA. Determinant-based classification of acute pancreatitis severity: An international multidisciplinary consultation. Ann Surg 2012;256:875-880.

11 Rocha FG, Balakrishnan A, Ashley SW, Clancy TE. A historic perspective on the contributions of surgeons to the understanding of acute pancreatitis. Am J Surg 2008;196:442-449.

12 Kiriyama S, Kozaka K, Takada T, Strasberg SM, Pitt HA, Gabata T, Hata J, Liau KH, Miura F, Horiguchi A, Liu KH, Su CH, Wada K, Jagannath P, Itoi T, Gouma DJ, Mori Y, Mukai S, Giménez ME, Huang WS, Kim MH, Okamoto K, Belli G, Dervenis C, Chan ACW, Lau WY, Endo I, Gomi H, Yoshida M, Mayumi T, Baron TH, de Santibañes E, Teoh AYB, Hwang TL, Ker CG, Chen MF, Han HS, Yoon YS, Choi IS, Yoon DS, Higuchi R, Kitano S, Inomata M, Deziel DJ, Jonas E, Hirata K, Sumiyama Y, Inui K, Yamamoto M. Tokyo guidelines 2018: Diagnostic criteria and severity grading of acute cholangitis (with videos). J Hepatobiliary Pancreat Sci 2018;25:17-30.

13 Iap/apa evidence-based guidelines for the management of acute pancreatitis. Pancreatology 2013;13:e1-15.

14 Pezzilli R, Zerbi A, Campra D, Capurso G, Golfieri R, Arcidiacono PG, Billi P, Butturini G, Calculli L, Cannizzaro R, Carrara S, Crippa S, De Gaudio R, De Rai P, Frulloni L, Mazza E, Mutignani M, Pagano N, Rabitti P, Balzano G. Consensus guidelines on severe acute pancreatitis. Dig Liver Dis 2015;47:532-543.

15 Crockett SD, Wani S, Gardner TB, Falck-Ytter Y, Barkun AN. American gastroenterological association institute guideline on initial management of acute pancreatitis. Gastroenterology 2018;154:1096-1101.

16 ASGE Standards of Practice Committee; Buxbaum JL, Abbas Fehmi SM, Sultan S, Fishman DS, Qumseya BJ, Cortessis VK, Schilperoort H, Kysh L, Matsuoka L, Yachimski P, Agrawal D, Gurudu SR, Jamil LH, Jue TL, Khashab MA, Law JK, Lee JK, Naveed M, Sawhney MS, Thosani N, Yang J, Wani SB. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. Gastrointest Endosc. 2019 Jun;89(6):1075-1105.e15.
17 Takada T, Isaji S, Mayumi T, Yoshida M, Takeyama Y, Itoi T, Sano K, Iizawa Y, Masamune A, Hirota M, Okamoto K, Inoue D, Kitamura N, Mori Y, Mukai S, Kiriyama S, Shirai K, Tsuchiya A, Higuchi R, Hirashita T. Jpn clinical practice guidelines 2021 with easy-to-understand explanations for the management of acute pancreatitis. J Hepatobiliary Pancreat Sci 2022
18 Tsumura H, Ichikawa T, Hiyama E, Kagawa T, Nishihara M, Murakami Y, Sueda T. An evaluation of laparoscopic cholecystectomy after selective percutaneous transhepatic gallbladder drainage for acute cholecystitis. Gastrointest Endosc 2004;59:839-844.
19 Papis D, Khalifa E, Bhogal R, Nair A, Khan S, Hamady Z, Ahmed J, Marangoni G. Is percutaneous cholecystostomy a good alternative treatment for acute cholecystitis in high-risk patients? Am Surg 2017;83:623-627.
20 Alexakis N, Lombard M, Raraty M, Ghaneh P, Smart HL, Gilmore I, Evans J, Hughes M, Garvey C, Sutton R, Neoptolemos JP. When is pancreatitis considered to be of biliary origin and what are the implications for management? Pancreatology 2007;7:131-141.
21 Isenmann R, Rau B, Beger HG. Early severe acute pancreatitis: Characteristics of a new subgroup. Pancreas 2001;22:274-278.
22 Andrews L. Endoscopic or surgical intervention for painful obstructive chronic pancreatitis. Gastroenterol Nurs 2016;39:401-402.
23 Tse F, Yuan Y. Early routine endoscopic retrograde cholangiopancreatography strategy versus early conservative management strategy in acute gallstone pancreatitis. Cochrane Database Syst Rev 2012:Cd009779.
24 Leppäniemi A, Tolonen M, Tarasconi A, Segovia-Lohse H, Gamberini E, Kirkpatrick AW, Ball CG, Parry N, Sartelli M, Wolbrink D, van Goor H, Baiocchi G, Ansaloni L, Biffl W, Coccolini F, Di Saverio S, Kluger Y, Moore E, Catena F. 2019 wses guidelines for the management of severe acute pancreatitis. World J Emerg Surg 2019;14:27.
25 Isogai M, Yamaguchi A, Hori A, Nakano S. Hepatic histopathological changes in biliary pancreatitis. Am J Gastroenterol 1995;90:449-454.
26 Isogai M, Hachisuka K, Yamaguchi A, Nakano S. Etiology and pathogenesis of marked elevation of serum transaminase in patients with acute gallstone disease. HPB Surg 1991;4:95-105; discussion 106-107.
27 Shan QY, Jiang H, Chen SL, Chen HD, Guo Y, Xie XY, Zhou LY. Postsurgical management of dilated biliary tract in children: Ultrasound-guided percutaneous transhepatic cholangial drainage and subsequent percutaneous ultrasound cholangiography. AJR Am J Roentgenol 2020;214:1377-1383.
28 Wang WD, Chen XW, He W, Liu QB, Wu ZQ. [effect of percutaneous transhepatic cholangial drainage with bile reinfusion and enteral nutrition via the nasojejunal tube on visceral protein and hepatic function]. Nan Fang Yi Ke Da Xue Xue Bao 2010;30:146-148.
29 Takada T, Yasuda H, Hanyu F. Technique and management of percutaneous transhepatic cholangial drainage for treating an obstructive jaundice. Hepatogastroenterology 1995;42:317-322.
30 Boxhoorn L, Voermans RP, Bouwense SA, Bruno MJ, Verdonk RC, Boermeester MA, van Santvoort HC, Besselink MG. Acute pancreatitis. Lancet 2020;396:726-734.

31 Marshall JC, Cook DJ, Christou NV, Bernard GR, Sprung CL, Sibbald WJ. Multiple organ dysfunction score: A reliable descriptor of a complex clinical outcome. Crit Care Med 1995;23:1638-1652.
32 Stigliano S, Belisario F, Piciucchi M, Signoretti M, Delle Fave G, Capurso G. Recurrent biliary acute pancreatitis is frequent in a real-world setting. Dig Liver Dis 2018;50:277-282.
33 Kundumadam S, Fogel EL, Gromski MA. Gallstone pancreatitis: General clinical approach and the role of endoscopic retrograde cholangiopancreatography. Korean J Intern Med 2021;36:25-31.
34 Venneman NG, Renooij W, Rehfeld JF, VanBerge-Henegouwen GP, Go PM, Broeders IA, van Erpecum KJ. Small gallstones, preserved gallbladder motility, and fast crystallization are associated with pancreatitis. Hepatology 2005;41:738-746.
35 van Santvoort HC, Bakker OJ, Bollen TL, Besselink MG, Ahmed Ali U, Schrijver AM, Boermeester MA, van Goor H, Dejong CH, van Eijck CH, van Ramshorst B, Schaapherder AF, van der Harst E, Hofker S, Nieuwenhuijs VB, Brink MA, Kruyt PM, Manusama ER, van der Schelling GP, Karsten T, Hesselink EJ, van Laarhoven CJ, Rosman C, Bosscha K, de Wit RJ, Houdijk AP, Cuesta MA, Wahab PJ, Gooszen HG. A conservative and minimally invasive approach to necrotizing pancreatitis improves outcome. Gastroenterology 2011;141:1254-1263.
36 Gliem N, Ammer-Herrmenau C, Ellenrieder V, Neesse A. Management of severe acute pancreatitis: An update. Digestion 2021;102:503-507.
37 Vege SS, DiMagno MJ, Forsmark CE, Martel M, Barkun AN. Initial medical treatment of acute pancreatitis: American gastroenterological association institute technical review. Gastroenterology 2018;154:1103-1139.
38 Zerem E. Treatment of severe acute pancreatitis and its complications. World J Gastroenterol 2014;20:13879-13892.
39 Bougard M, Barbier L, Godart B, Le Bayon-Bréard AG, Marques F, Salamé E. Management of biliary acute pancreatitis. J Visc Surg 2019;156:113-125.
40 Greenberg JA, Hsu J, Bawazeer M, Marshall J, Friedrich JO, Nathens A, Coburn N, May GR, Pearsall E, McLeod RS. Clinical practice guideline: Management of acute pancreatitis. Can J Surg 2016;59:128-140.
41 Saxena P, Kumbhari V, Zein ME, Khashab MA. Preoperative biliary drainage. Dig Endosc 2015;27:265-277.
42 Beger HG, Rau BM. Severe acute pancreatitis: Clinical course and management. World J Gastroenterol 2007;13:5043-5051.
43 Hirota M, Takada T, Kitamura N, Ito T, Hirata K, Yoshida M, Mayumi T, Kataoka K, Takeda K, Sekimoto M, Hirota M, Kimura Y, Wada K, Amano H, Gabata T, Arata S, Yokoe M, Kiriyama S. Fundamental and intensive care of acute pancreatitis. J Hepatobiliary Pancreat Sci 2010;17:45-52.