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Impact of the Timing of Percutaneous Catheter Drainage following Endoscopic Drainage on Outcomes in Acute Necrotizing Pancreatitis

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Abstract

Background The role of dual-modality drainage of walled-off necrosis (WON) in patients with acute pancreatitis (AP) is established. However, there are no data on the association of clinical outcomes with the timing of percutaneous catheter drainage (PCD). We investigated the impact of the timing of PCD following endoscopic drainage of WON on clinical outcomes in AP.

Materials and Methods This retrospective study comprised consecutive patients with necrotizing AP who underwent endoscopic cystogastrostomy (CG) of WON followed by PCD between September 2018 and March 2023. Based on endoscopic CG to PCD interval, patients were divided into groups ($\leq$ and $>$3 days, $\leq$ and $>$1 week, $\leq$ and $>$10 days, and $\leq$ and $>$2 weeks). Baseline characteristics and indications of CG and PCD were recorded. Clinical outcomes were compared between the groups, including length of hospitalization, length of intensive care unit stay, need for surgical necrosectomy, and death during hospitalization.

Results Thirty patients (mean age $\pm$ standard deviation, 35.5 ± 12.7 years) were evaluated. The mean CG to PCD interval was 11.2 ± 7.5 days. There were no significant differences in baseline characteristics and indications of CG and PCD between the groups. The mean pain to CG interval was not significantly different between the groups. Endoscopic necrosectomy was performed in a significantly greater proportion of patients undergoing CG after 10 days ($p = 0.003$) and after 2 weeks ($p = 0.032$). There were no significant differences in the complications and clinical outcomes between the groups.

Conclusion The timing of PCD following endoscopic CG does not affect clinical outcomes.

Keywords
- acute pancreatitis
- collections
- drainage
- endoscopy
- catheter

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Introduction

There has been a paradigm shift in the management of walled-off necrosis (WON) in patients with acute pancreatitis (AP). The step-up approach is the standard treatment protocol for infected or symptomatic WON.[1,2] This approach involves minimally invasive drainage (endoscopic or percutaneous) followed by necrosectomy, if required. Endoscopic drainage is the procedure of choice for WON accessible via the upper gastrointestinal tract.[3,4] However, extensive WON (extending into deeper retroperitoneal spaces) may need dual-modality drainage comprising endoscopic drainage and percutaneous catheter drainage (PCD).[5,6] Previous studies have shown the potential benefit of dual-modality drainage over endoscopic drainage or PCD alone.[7–10] However, both drainage procedures were done on the same day in the previous studies. In practice, PCD is performed at a variable interval after endoscopic drainage, if the patients have persistent sepsis or organ failures (OFs). We hypothesized that early PCD following endoscopic drainage of WON may improve outcomes in patients with acute necrotizing pancreatitis. To our knowledge, there is no prior study evaluating the impact of the timing of PCD following endoscopic drainage. Thus, we aimed to compare the clinical outcomes of early versus late PCD (groups based on various time interval cut-offs) in patients who have undergone prior endoscopic drainage for extensive WON.

Materials and Methods

Patient Inclusion

The institutional ethics committee approved this retrospective study, and the need for written informed consent was waived. Consecutive patients with extensive WON (WON in lesser sac extending into deeper retroperitoneal spaces-pararenal spaces, paracolic gutters) who underwent endoscopic cystogastrostomy (CG) followed by PCD (of deeper retroperitoneal collection with or without drainage of the lesser collection where CG stents were placed) between September 2018 and March 2023 were included. The diagnosis of AP was based on the revised Atlanta classification criteria (two or more of the following): typical pancreatic-type abdominal pain, the elevation of serum amylase or lipase levels to more than three times the upper limit of normal, and imaging findings of AP.[11] WON was defined as inhomogeneous encapsulated collections after 4 weeks of disease onset (per revised Atlanta classification). Infected or symptomatic WONs amenable to transgastric/transduodenal approach underwent endoscopic CG.[2,3] Infected WON was suspected based on the clinical signs of infection, including nonresolving OF, persistent (>3 days) fever, leukocytosis, elevated C-reactive protein, or the presence of gas within the collection. Infected necrosis was confirmed by culture of the fluid aspirated during the first drainage procedure. The decision to perform PCD after endoscopic CG was based on the evaluation by a multidisciplinary team comprising medical gastroenterologists, surgical gastroenterologists, and interventional radiologists. Indications of PCD after CG included persistent or worsening systemic inflammatory response syndrome or OF following endoscopic drainage and evidence of residual collection amenable to percutaneous drainage (more than 2 cm in anteroposterior dimension). Exclusion criteria included patients with recurrent AP, acute on chronic pancreatitis, and patients with incomplete clinical details.

The patients were divided, based on the interval between endoscopic CG and PCD, into early and late groups. Multiple cut-offs were considered, including 3 days, 1 week, 10 days, and 2 weeks, for dividing the patients into two groups. We used multiple cut-offs as there is no guidance from the published literature regarding a single best time interval between CG and PCD that is effective. Multiple cut-offs account for all the possible clinical scenarios.

Clinical Evaluation

All patients were managed as per standard guidelines. The following clinical parameters were recorded: the etiology and severity of AP and the presence of OF. The severity of AP was per the revised Atlanta classification, while OF was defined as per modified Marshall scoring.

Computed Tomography Scan Protocol

Per the institutional protocol, contrast-enhanced computed tomography (CT) was performed between 5 and 7 days from the onset of pain to evaluate the extent of pancreatic and peripancreatic necroses in patients with moderately severe and severe AP. CT was repeated a day before endoscopic drainage. Patients underwent CT in the portal venous phase on a multidetector row scanner 70 seconds after administration of 80 to 100 mL of nonionic intravenous contrast at 2.5 mL/s. Arterial phase scans were acquired in patients with suspected hemorrhagic complications after intravenous injection of 100 mL of nonionic contrast at a rate of 4 mL/s. The scanning was triggered using the bolus tracking technique.

Recording of CT Findings

The modified CT severity index (MCTSI) was recorded at baseline CT. The extension of the collection beyond the lesser sac and the largest dimension of the collection were recorded. The presence of ascites and pleural effusion was also recorded.

Management

All patients were managed as per standard recommendations.[12] Analgesia, fluid resuscitation, oxygen, and nutritional support (enteral or parenteral) were provided. Antibiotics were administered for suspected infected necrosis. Management of pancreatic fluid collection followed the step-up approach. Endoscopic CG and PCD were performed as detailed later.

Endoscopic Cystogastrostomy

Experienced endosonologists performed endoscopic ultrasound (EUS)-guided drainage under conscious sedation. The endoscopic drainage procedure followed the previous

standard technique.[7] In brief, the collection was punctured under EUS guidance after securing a vessel-free approach. After creating a fistula with either cystotome, bougie dilator, or biliary balloon, plastic stents or metallic stents were placed, and necrosectomy was performed at the discretion of the endosonologist.[7,13] CT was performed on the third day after CG to assess the position of the stent and residual collection.

Percutaneous Catheter Drainage

PCD was done under ultrasound or CT guidance using the Seldinger technique by an interventional radiologist with 8 years of experience.[14] A 14-Fr Malecot catheter was placed. The catheter was flushed daily with 50 to 100 mL of normal saline. Catheter upsizing was every 3 to 5 days in patients with reduced catheter output and evidence of residual collection on ultrasound or CT. The catheter was removed once the collection was resolved, and there was less than 10 mL output for 3 consecutive days.

Surgical Necrosectomy

Patients who did not show significant clinical improvement with endoscopic CG and PCD were treated with surgical necrosectomy per the standard step-up approach.[2]

Recording of Procedure Details

The following procedure details were recorded—the interval between pain onset and endoscopic CG, indications of endoscopic CG, type of stent (plastic vs. metal), endoscopic necrosectomy, complications of EUS CG, the interval between EUS drainage and PCD, the mean size of the residual collection at the time of PCD, the indication of PCD, site of PCD, duration of PCD, catheter size, and PCD complications.

Outcomes Assessed

Length of hospitalization, need for intensive care unit (ICU) admission (after PCD), length of ICU stay (calculated as number of days after PCD, if patients were already in ICU), need for surgical necrosectomy, and death during hospitalization were the outcomes assessed.

Statistical Analysis

The data were entered into an Excel sheet. The continuous variables were presented as mean with standard deviation and the categorical variables are presented as proportions or percentages. The continuous variables were compared using Student's *t*-test or Mann–Whitney's *U*-test depending on the distribution (tested by Kolmogorov–Smirnov's test). The categorical variables were compared using chi-square test or Fischer's exact test. A p-value of < 0.05 was considered statistically significant. All statistical tests were done using SPSS version 22.

Results

Patients and Baseline Characteristics

Forty patients underwent PCD after endoscopic drainage during the study period. Four patients with acute on chronic pancreatitis and six patients with incomplete clinical data were excluded. Thus, the data of 30 patients were analyzed (►**Fig. 1**). The mean age was 35.5 ± 12.7 years. There were 22 (73.3%) males and 8 (26.7%) females. Moderately severe and severe diseases were present in 14 (46.7%) and 16 (53.3%) patients. OF was seen in 20 patients (66.7%). Twenty-eight (93.3%) patients were suspected of having infected necrosis based on the clinical features or CT findings. Infection was confirmed by culture in 22 of 28 (78.6%) patients. Ascites and pleural effusion were present in 22 (73.3%) and 24 (80%) patients, respectively (►**Table 1**).

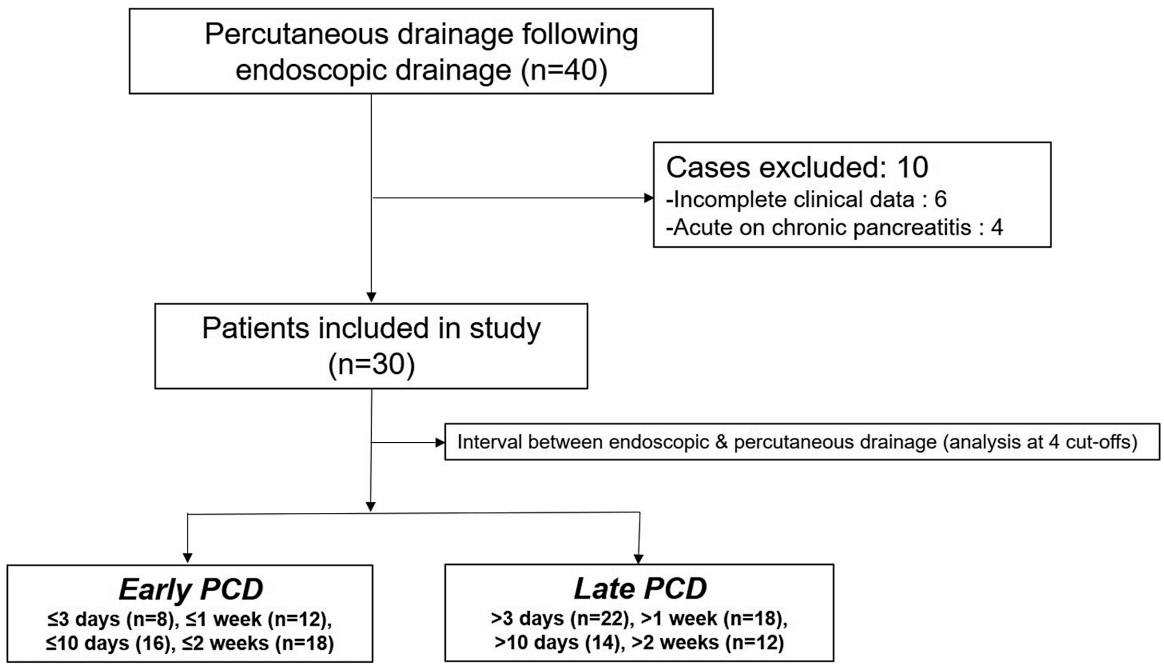

Fig. 1 Flow diagram showing patient recruitment in the study. PCD, percutaneous catheter drainage.

Table 1 Comparison of baseline characteristics between the groups

Parameter	3-d cut-off		*p*-Value	1-wk cut-off		*p*-Value	10-d cut-off		*p*-Value	2-wk cut-off		*p*-Value
	≤ 3 d (*n* = 8)	> 3 d (*n* = 22)		≤ 1 wk (*n* = 12)	> 1 wk (*n* = 18)		≤ 10 d (*n* = 16)	> 10 d (*n* = 14)		≤ 2 wk (*n* = 18)	> 2 wk (*n* = 12)	
Age (mean ± SD)	34.3 ± 13.3	34.3 ± 12.5	0.463	37.1 ± 13.4	34.3 ± 12.3	0.75	33.5 ± 13.9	35.3 ± 11.5	0.822	33 ± 14	35.5 ± 10.1	0.632
Gender (males, females)	6, 2	16, 6	0.901	9, 3	13, 5	0.861	11, 5	11, 3	0.544	13, 5	9, 3	0.898
Etiology												
Gallstones	2 (25)	12 (54.5)	0.353	4 (33.3)	10 (55.5)	0.421	7 (43.7)	7 (50)	0.924	7 (38.9)	7 (58.3)	0.516
Alcohol	4 (50)	7 (31.8)		6 (50)	5 (27.7)		6 (37.5)	5 (35.7)		8 (44.4)	3 (25)	
Others	2 (25)	3 (13.6)		2 (8.3)	3 (11.1)		3 (18.7)	2 (14.2)		3 (16.6)	2 (16.6)	
Severity												
Moderately severe	4 (50)	10 (45.5)	0.825	7 (58.3)	7 (38.9)	0.251	10 (62.5)	4 (28.5)	0.284	10	4	0.271
Severe	4 (50)	12 (54.5)		5 (41.7))	11 (61.1)		8 (50)	8 (44.4)		8	8	
MCTSI (median, range)	10 (6–10)	8 (6–10)	0.377	10 (6–10)	8 (6–10)	0.514	8 (6–10)	8 (8–10)	0.881	8 (6–10)	8 (6–10)	0.984
Organ failure	5	15 (68.2)	0.770	6 (50)	14 (77.8)	0.139	9 (56.2)	11 (78.6)	0.261	10	10	0.176
Ascites	7	15 (68.2)	0.290	8 (66.7)	14 (77.8)	0.678	10 (62.5)	12 (85.7)	0.226	11	11	0.065
Pleural effusion	8 (100)	16 (72.7)	0.099	9 (75)	15 (83.3)	0.661	13 (81.2)	11 (78.6)	0.605	13	11	0.123
Largest dimension of lesser sac collection in cm (mean ± SD)	15.7 ± 5.2	10.6 ± 3.3	**0.030**	13.0 ± 4.8	10.6 ± 3.5	0.313	12.8 ± 4.9	10.4 ± 4.2	0.473	15.8 ± 12.7	14.9 ± 11.9	0.718

Abbreviations: MCTSI, modified computed tomography severity index; SD, standard deviation.
Note: Numbers in parenthesis represent percentages. Bold values are statistically significant.

There was extension to left pararenal space in all patients, left paracolic gutter in 11 (36.7%) patients, right anterior pararenal space in 4 (13.3%) patients, right paracolic gutter in 2 (6.7%) patients, pelvis in 2 (6.7%) patients, perihepatic space in 2 (6.7%) patients, perisplenic space in 2 (6.7%) patients, and omentum in 2 (6.7%) patients. The mean size of lesser sac collection at baseline was 14.5 ± 12.2 cm. The mean pain to CG interval was 71 ± 72.1 days (range: 28–313 days). Mean size of the residual collection after CG was 3.9 ± 3.5 days. One patient had lower gastrointestinal bleeding following CG. It was resolved after 2 days without intervention. Self-limiting bleeding from the percutaneous catheter occurred in four patients. No major complications were encountered following CG or PCD.

Comparison of Early and Late PCD Groups

►**Table 2** compares the clinical characteristics and endoscopic and percutaneous interventions between the groups. There were no significant differences in age, sex, etiology, severity of AP, and OF between the groups. The mean pain to CG interval and the indications of drainage were comparable between the groups.

There was no significant difference in the type of stents placed in the two groups. However, endoscopic necrosectomy was performed in a significantly greater proportion of patients undergoing PCD after 10 days ($p = 0.003$) and after 2 weeks ($p = 0.032$). There was no significant difference in the complications between the groups.

There was no difference in the indications of PCD between the groups. The location of PCD, catheter size, need for upgradation, mean duration of PCD, and PCD-related complications also did not differ significantly between the groups (►**Figs. 2** and **3**).

Clinical Outcomes

The groups did not differ in the length of hospitalization after CG, need for ICU admission, length of ICU stay, need for surgical necrosectomy, and deaths during admission (►**Table 3**). Death occurred after a mean duration of 24 ± 13.6 days after PCD.

Discussion

This retrospective study evaluated the impact of the timing of PCD following endoscopic drainage in patients with AP. Patients undergoing early PCD (defined using different time cut-offs) were compared with those undergoing late PCD after CG. The groups were comparable in terms of baseline parameters. There was no significant difference in the clinical outcomes between the groups.

Patients with necrotizing AP often require a multimodality approach for drainage of WONs, including endoscopic, percutaneous, and surgical. The step-up approach consists of initial endoscopic or percutaneous drainage followed by necrosectomy (endoscopic/surgical) in patients who do not show clinical improvement with drainage alone.[2] There has been a paradigm shift in managing WON from open surgery to minimally invasive procedures.[15–18] The focus has

Table 2 Comparison of endoscopic and percutaneous interventions between the groups

Parameter	3-d cut-off		*p*-Value	1-wk cut-off		*p*-Value	10-d cut-off		*p*-Value	2-wk cut-off		*p*-Value
	≤ 3 d ($n = 8$)	> 3 d ($n = 22$)		≤ 1 wk ($n = 12$)	> 1 wk ($n = 18$)		≤ 10 d ($n = 16$)	> 10 d ($n = 14$)		≤ 2 wk ($n = 18$)	> 2 wk ($n = 12$)	
Endoscopic drainage												
Pain to CG interval (d, mean ± SD)	52.1 ± 48.1	78.5 ± 67.4	0.341	58.8 ± 57.3	80.4 ± 76.5	0.436	59.3 ± 52.7	85.3 ± 78.9	0.178	61.8 ± 52.3	85.9 ± 96.4	0.384
Lesser sac collection size after CG (largest dimension)	5.71 ± 3.7	3.3 ± 3.2	0.121	5.71 ± 3.3	2.8 ± 3.2	**0.026**	5.3 ± 3.3	2.3 ± 3.1	**0.016**	4.9 ± 3.3	2.4 ± 3.2	0.057
Indications												
Suspected infection	8 (100)	20 (90.1)	0.787	11 (91.7)	17 (94.4)	0.505	16 (100)	12 (85.7)	0.462	17 (94.4)	11 (91.7)	0.922
Biliary or gastric outlet obstruction	0	2 (9.1)		0	2 (11.1)		0	2 (14.3)		1 (5.6)	1 (8.3)	
Type of stent												
Plastic	3 (37.5)	9 (40.9)	0.160	5 (41.7)	7 (38.9)	0.186	8 (50)	4 (28.5)	0.191	9 (50)	3 (25)	0.061
Metallic	4 (50)	4 (18.2)		5 (41.7)	3 (16.7)		5 (31.2)	3 (21.4)		6 (33.3)	2 (16.7)	
Plastic and Metal	1 (12.5)	9 (40.9)		2 (16.7)	8 (44.4)		3 (18.5)	7 (50)		3 (16.7)	7 (58.3)	
Endoscopic necrosectomy	2 (25)	13 (59.1)	0.099	4 (33.3)	11 (61.1)	0.136	4 (25)	11 (78.6)	**0.003**	5 (27.8)	10 (83.3)	**0.032**
Complications (bleeding)	0	1 (4.5)	0.540	0	1 (5.5)	0.406	0	1 (7.1)	0.277	0	1 (8.3)	0.217
Percutaneous drainage												
CG to PCD interval (d, mean ± SD)	1.2 ± 4.6	14.8 ± 8.2	< **0.001**	2.1 ± 1.5	17.2 ± 7.7	< **0.001**	3.5 ± 2.7	20.1 ± 6.3	< **0.001**	4.3 ± 3.5	21.5 ± 5.4	< **0.001**

(*Continued*)

Table 2 (*Continued*)

Parameter	3-d cut-off		*p*-Value	1-wk cut-off		*p*-Value	10-d cut-off		*p*-Value	2-wk cut-off		*p*-Value
	≤ 3 d (*n* = 8)	> 3 d (*n* = 22)		≤ 1 wk (*n* = 12)	> 1 wk (*n* = 18)		≤ 10 d (*n* = 16)	> 10 d (*n* = 14)		≤ 2 wk (*n* = 18)	> 2 wk (*n* = 12)	
Indications												
Persistent SIRS	4 (50)	15 (68.2)	0.361	7 (58.3)	12 (66.7)	0.643	10 (62.5)	9 (64.3)	0.919	12 (66.7)	7 (58.3)	0.613
Nonresolving OF	4 (50)	7 (31.8)		5 (41.7)	6 (33.3)		6 (37.5)	5 (35.7)		6 (33.3)	5 (41.7)	
Site of PCD												
Lesser sac	3 (37.5)	6 (27.3)	0.524	3 (25)	6 (33.3)	0.295	4 (25)	5 (35.7)	0.113	6 (33.3)	3 (25)	0.975
Left anterior pararenal space	3 (37.5)	9 (40.9)		4 (33.3)	8 (44.4)		5 (31.2)	7 (50)		7 (38.9)	5 (41.7)	
Left paracolic gutter	1 (12.5)	3 (13.6)		1 (8.3)	3 (16.7)		1 6.25)	3 (21.4)		2 (11.1)	2 (16.7)	
Right anterior pararenal space	1 (12.5)	2 (9.1)		1 (8.3)	2 (11.1)		1 (6.25)	2 (14.3)		2 (11.1)	1 (8.3)	
Right paracolic gutter	0	1 (4.5)		0	1 (5.5)		0	1 (7.1)		0	1 (8.3)	
Omentum	0	1 (4.5)		0	1 (5.5)		0	1 (7.1)		1 (5.6)	0	
Duration of PCD (d, mean ± SD)	23.4 ± 16.7	29.5 ± 17.9	0.436	25.5 ± 14.8	29.5 ± 19.3	0.280	26.4 ± 14.4	29.7 ± 20.8	0.307	27.1 ± 19.1	27 ± 21.1	0.621
Median catheter size (Fr, range)	14 (14–24)	14 (14–24)	0.917	14 (14–22)	14 (14–24)	0.391	14 (14–24)	14 (14–24)	0.477	14 (14–22)	14 (14–24)	0.221
Complications (bleeding)	1 (12.5)	3 (13.6)	0.935	3 (25)	1 (5.5)	0.125	3 (18.5)	1 (7.1)	0.351	3 (16.7)	1 (8.3)	0.518

Abbreviations: CG, cystogastrostomy; OF, organ failure; PCD, percutaneous catheter drainage; SD, standard deviation; SIRS, systemic inflammatory response syndrome.
Note: Numbers in parenthesis represent percentages. Bold values are statistically significant.

Fig. 2 Group 1: endoscopic to percutaneous catheter drainage interval of 6 days. (**A, B**) Contrast-enhanced computed tomography (CT) in fourth week of illness showing walled-off necrotic (WON) collections in lesser sac location with extension to the omentum. Cystogastrostomy was done on day 27 of the illness. As patients had persistent systemic inflammatory response syndrome and nonresolving organ failure, percutaneous catheter drainage for the omental component was done on day 33 of the illness; (**C, D**) CT shows cystogastrostomy stent (thick white arrow in **C**) and percutaneous catheter (dashed white arrow in **D**) in situ; (**E, F**) CT in the seventh week shows a significant decrease in size of WON.

primarily shifted to endoscopic and percutaneous drainage techniques. Both techniques are comparable in terms of outcomes, with few studies reporting endoscopic to be superior.[3,19] However, both methods are complementary and must be used as an adjunct depending on the patient's clinical condition and the collection's location. Endoscopic CG drains WON located only in the lesser sac/in the vicinity of the stomach and duodenum.[16] WONs frequently extend into deeper tissues of the retroperitoneum, including pararenal spaces, paracolic gutters, and pelvis.[6] PCD must be used as an adjunct for symptomatic/infected WONs that do not drain entirely via the endoscopic approach.

Data regarding the outcomes of the dual-modality drainage technique are emerging. Dual modality is associated with better clinical outcomes, shorter hospital stay, lesser need for surgical necrosectomy and repeat endoscopic cholangiopancreatography, and lower risk of pancreatocutaneous fistula compared with those undergoing PCD only.[7–9] Recently, the feasibility and safety of dual-modality drainage in the first 4 weeks of illness have also been reported.[10] Most studies that reported outcomes of dual-modality drainage performed both procedures on the same day.[7–10] Rana et al reported a combined approach comprising initial PCD followed by endoscopic drainage in patients

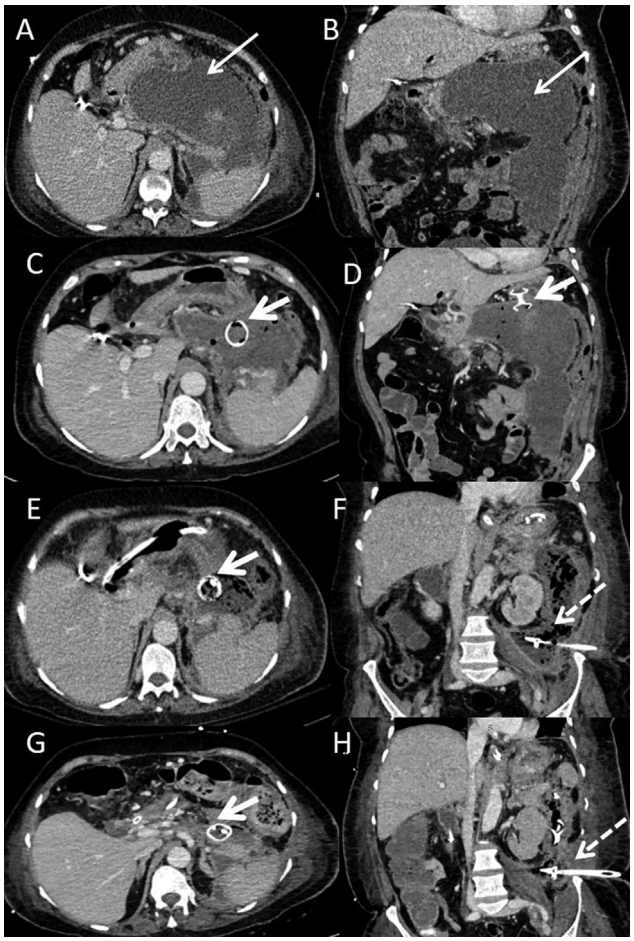

Fig. 3 Group 2: endoscopic to percutaneous catheter drainage interval of 18 days: (**A, B**) Contrast-enhanced computed tomography (CT) showing walled-off necrotic (WON) collections in lesser sac with extension into the left pararenal space and left paracolic gutter (white arrows). Cystogastrostomy was done on day 33 of the illness. (**C, D**) CT after cystogastrostomy shows the stent in situ (thick white arrows) with significant collection in the left paracolic gutter. Percutaneous catheter drainage was done on day 51 of the illness; (**E, F**) CT after percutaneous catheter insertion (dashed white arrow in **F**); (**G, H**) CT done in the ninth week of illness shows a significant reduction in the size of WON.

who did not respond to PCD alone as safe and effective for patients with infected WONs.[20] However, to our knowledge, none of the reported studies has systematically reported the impact of the timing of PCD following initial endoscopic drainage of WON.

There were a few limitations to our study. First, due to the study's retrospective nature, the timing of PCD was arbitrary, as decided by a multidisciplinary team. The patients were divided arbitrarily into early and late groups using different cut-offs. Second, the sample size was small and not balanced between the groups. This may have impacted the statistical significance of the outcomes. Third, due to the small sample size, we could not evaluate the impact of factors such as the type of stents, stent exchanges, and site of drainage on dual modality. Finally, we did not report the long-term outcomes.

Table 3 Comparison of clinical outcomes between the groups

Clinical outcomes	3-d cut-off		*p*-Value	1-wk cut-off		*p*-Value	10-d cut-off		*p*-Value	2-wk cut-off		*p*-Value
	≤ 3 d ($n = 8$)	> 3 d ($n = 22$)		≤ 1 wk ($n = 12$)	> 1 wk ($n = 18$)		≤ 10 d ($n = 16$)	> 10 d ($n = 14$)		≤ 2 wk ($n = 18$)	> 2 wk ($n = 12$)	
LOH after CG (mean ± SD)	25 ± 15.8	28.1 ± 16.8	0.646	24.8 ± 15.4	29 ± 17.1	0.504	27.1 ± 14.3	27.5 ± 18.9	0.943	26.4 ± 16.8	27.1 ± 16.3	0.912
Need for ICU admission[a]	3 (37.5)	5 (22.7)	0.418	4 (33.3)	4 (22.2)	0.500	4 (25)	4 (28.6)	0.825	4 (22.2)	4 (33.3)	0.500
Length of ICU stay (mean ± SD)[a]	6.6 ± 5.5	3.5 ± 3.2	0.178	8.3 ± 5.5	1.7 ± 3.5	0.089	6.2 ± 3.8	2.2 ± 1.9	0.288	5.5 ± 4.9	2.6 ± 2.1	0.470
Surgical necrosectomy	0	2 (9.1)	0.377	0	2 (11.1)	0.232	1 (6.2)	1 (7.1)	0.922	2 (11.1)	0	0.219
Death	3 (37.5)	3 (13.6)	0.148	3 (25)	3 (16.6)	0.576	4 (25)	2 (14.3)	0.464	5 (27.8)	1 (8.3)	0.192

Abbreviations: CG, cystogastrostomy; ICU, intensive care unit; LOH, length of hospitalization; SD, standard deviation.
Note: Numbers in parenthesis represent percentages.
[a]After percutaneous catheter drainage.

Conclusion

In conclusion, dual-modality drainage comprising initial endoscopic drainage followed by PCD is safe and effective, and the interval between endoscopic drainage and PCD has no impact on clinical outcomes. However, prospective randomized trials should be performed to confirm the findings of our study.

Ethical Approval and Patient Consent

The institute ethics committee approved the study and waived the consent to obtain consent due to its retrospective nature.

Authors' Contributions

H.B., S.V., P.G., S.F., A.K., and J.J. contributed to data acquisition, analysis, initial draft, revision, and final approval. J.S., A.S., V.J., H.M., J.S., V.S., S.K.S., U.D., and R.K. contributed to data acquisition, revision, and final approval.

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Conflict of Interest

None declared.

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