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Predictors of Surgery in Patients with Severe Acute Pancreatitis Managed by Step up Approach

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KEYWORDS

step-up approach, Acute Pancreatitis

ABSTRACT:

Background: Severe acute pancreatitis (SAP) is initially treated conservatively. Saline irrigation combined with percutaneous catheter drainage (PCD) is reportedly a successful step-up strategy. It's uncertain what causes surgery. **Methods:** Seventy consecutive SAP patients were chosen for this ongoing prospective investigation. Using a step-up strategy, every patient was first treated medically before having PCD and surgery performed when necessary. Findings: Of the 70 consecutive SAP patients, 14 were treated medically, 29 were treated only with PCD, and 27 needed surgery in addition to PCD at the beginning. Sixty-two percent of patients had sepsis reversal with PCD monotherapy. In 27 patients (48%), PCD alone proved to be a curative therapy. The group's overall mortality rate was 24 percent. The starting acute physiology and chronic health assessment (APACHE) II score, the APACHE II score at first intervention, sepsis reversal by PCD within one week, the amount of organs failed, organ failure within a week of the illness beginning, the number of bacteria isolated per patient, renal failure, respiratory failure, Escherichia coli, the computerised tomography extent index score at admission, the need for parenteral nutrition before or after radiological action, the greatest degree of necrosis of more than 50% of the pancreas, and extrapancreatic necrosis were among the factors that significantly affected surgical intervention in univariate analysis. Renal failure (P -0.03), the APACHE II score at the time of the first intervention (P -0.006), and the total number of of bacteria isolated per patient (P –0.01) remained independent predictors of surgery. An APACHE II score of more than 7.5 at first intervention (PCD) had the ability to predict surgery with a sensitivity of 88.9% and a specificity of 69%. **Conclusions:** In 62% of patients, PCD prevented surgery whereas in 48% of cases, it reversed sepsis. Early disease progression may require surgery if sepsis is reversed within a week of PCD, if the APACHE II score is high at the time of initial intervention (PCD), and if organ failure occurs within a week of the commencement of the illness.

Introduction

The updated Atlanta classification categorises acute pancreatitis (AP) into three severity levels: mild (MAP), moderately serious (MSAP), and severe (SAP). Computed tomography (CT) observations of acute peripancreatic fluid accumulation are nearly universal in patients with MSAP/SAP. Conservative administration of sterile fluid collections in AP is recommended by certain early guidelines. According to Walser et al.'s research, the risk of catheter drainage-related sterile collection infection was 59% (13/22 patients) as opposed to 20% (3/15 patients) for collections that were only aspirated.[1]

Acute pancreatitis (AP) is a systemic inflammatory response syndrome (SIRS) with significant intensity variation that is characterised by a (first) sterile

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inflammation of the pancreas. About 80 percent of patients have moderate symptoms that only need to be managed with water, analgesics, and a return to a regular diet. However, a tiny percentage of patients are being admitted to intensive care units (ICUs) in the initial stages as a result of a severe SIRS reaction that results in persistent (multiple) organ failure. There are currently no targeted treatments accessible to lessen or avoid this, except from assistance while the inflammation persists.[2]

Infected (peri-) pancreatic necrosis continues to be a difficulty for doctors despite newer treatment options like the surgical and endoscopic step-up approaches[3] that have been implemented in the majority of clinics. According to a recent statewide survey, the average hospital death rate for patients with acute pancreatitis who were hospitalised to Dutch intensive care units (ICUs) has stayed constant at 23% over the past 20 years.[4] Nonetheless, prior to 2010—that is, until the PANTER trial's publication date—all-cause 1-year mortality was greater for patients with late death (after 14 days), indicating that the majority of improvements had been made in the management of late problems. The objective of this study was to identify factors that led to surgical intervention after initial management with PCD, and also to identify a subgroup of patients where PCD alone would be effective.

Methodology

A prospective investigation was conducted at the Meenakshi Medical College, Hospital and Research Institute in Kanchipuram, in the department of general surgery. SAP was diagnosed using clinical observations, biochemical data, and CTSI in accordance with UK criteria and the Atlanta Classification. Prior to enrollment, each patient gave written, informed permission. The Helsinki Declaration's (modified in 2000) guidelines were followed in the execution of this investigation. The procedure has been accepted by the institutional ethics committee. Participants in the trial had to have severe acute pancreatitis along with one or more of the following: single- or multiorgan failure, CTSI ≥ 7 (first CT scan done among day 4 and day 14), and APACHE II score ≥ 8. Patients who had previously undergone exploratory laparotomy for an acute abdomen and an intraoperative diagnosis of pancreatitis, as well as those who had previously undergone percutaneous drainage or surgical necrosectomy for (suspected) pancreatic necrosis in the current episode of pancreatitis, were ruled out at the exact same period. At first, all patients underwent medical management as a step-up strategy. Whenever recommended, image-guided fine-needle aspiration and PCD were used as the following phase. As per the recommendation, the third stage involved performing an open surgical necrosectomy (Fig. 1).

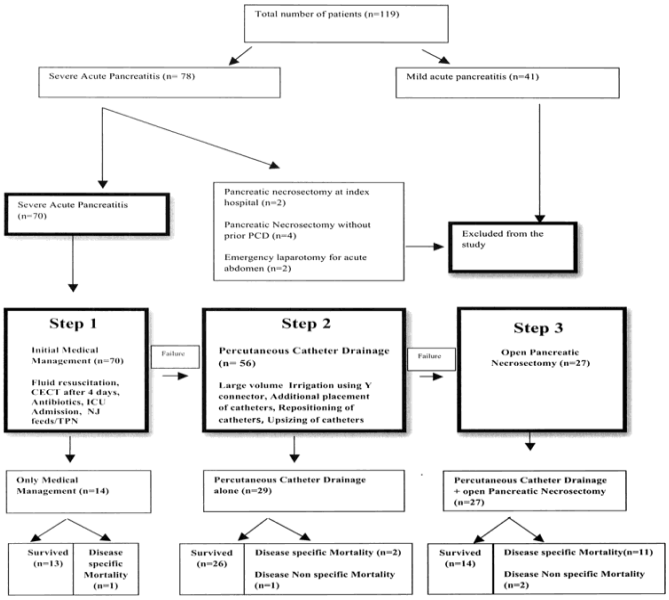

Figure 1. Enrollment of patients.

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Indications of Image-Guided Fine-Needle Aspiration and Percutaneous Catheter Drainage (PCD)

Patients with persistent fever, leukocytosis, worsening or newly onset organ failure, and gas in the pancreatic bed who did not respond well to medical treatment. The following conditions were indicative of a need for a pancreatic necrosectomy: ongoing sepsis, inadequate drainage of collection and necrosis, failure to thrive, continually elevated leukocyte count or a rising trend of leukocyte count, persistently deteriorating organ failure or new-onset organ failure, and presence of ongoing necrosis with bowel difficulties (eg, necrosis, uncontrolled fistula, obstruction).

Management Protocol

Within 48 hours of admission, every individual had a full hemogram, coagulogram, serum calcium levels, liver and renal function testing, and blood gas analysis. The patient had blood cultures obtained when they were feverish. Ciprofloxacin and metronidazole were prescribed to patients who satisfied the inclusion criteria and reported directly to our division. Until a modification was required due to a culture sensitivity report, all other patients were kept on the same antibiotics that were started by their parental unit before to referral. The first contrast-enhanced CT scan (CECT) was carried out four days after the disease started, and it was then repeated based on the results. Each patient's APACHE II score and Balthazar CTSI were determined upon enrollment, and they were also repeatedly calculated prior to and after intervention.

Patients were released from the hospital with catheters in place if they had made a clinical recovery but still had purulent leakage. The hospitalized individuals received instruction on at-home irrigation and catheter maintenance prior to being released. Patients came to follow-up outpatient appointments in both our department and the intervention radiology unit.

Criteria for Catheter Removal

1. Catheter output of less than 10 milliliters per day of nonpurulent fluid for 2 consecutive days (after adequate flushing and ensuring the patency) with normal amylase levels
2. No residual collection on a serial CT scan/ultrasonography (USG)(Fig. 3)
3. Clinical recovery, ie, no fever, accepting normal diet, gaining weight, able to carry out routine activities

Primary Endpoints

1. Sepsis reversal with PCD
2. Proportion of patients requiring surgical necrosectomy after initial PCD
3. Identification of factors that predicted the need for surgery in patients initially treated with PCD

Secondary Endpoints

1. Morbidity in patients managed with PCD
2. Length of intensive care unit (ICU) and hospital stay
3. Number and size of catheters required
4. Number of interventions required
5. Catheter-related complications
6. Morbidity and mortality in patients requiring necrosectomy.

Results

78 patients had SAP and 41 had mild acute pancreatitis, who were not included in the research, out of the 119 patients with acute pancreatitis who were admitted to our division between April 2008 and January 2010. Eight patients were withdrawn from the research: two went through open pancreatic necrosectomy with no initial PCD after having a pancreatic necrosectomy at an index hospital, two more went through a laparotomy for an acute abdomen after learning intraoperatively that they had acute pancreatitis). Of the 70 patients who were recruited for the trial, 29 had PCD alone, and 14 were treated solely with medical therapy. Following initial PCD, the remaining 27 patients required surgical necrosectomy (Fig. 1).

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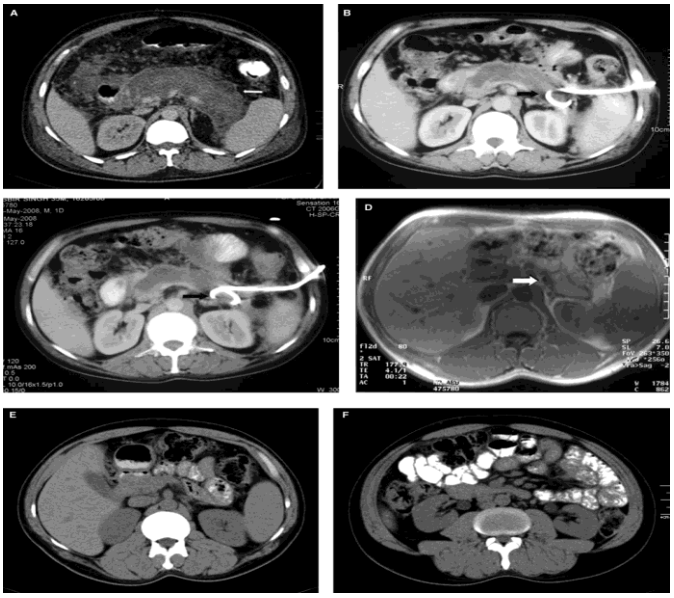

Figure 2. A, CECT abdomen (day 10 after the onset of pancreatitis) showing near-complete necrosis of the pancreas. B, CECTabdomen (day 43 after the onset of pancreatitis) showing PCD in the body and tail region of the pancreas; PCD insertion doneon day 18 of the disease. C, CECT abdomen (day 58 after the onset of pancreatitis) showing PCD in the body and tail region ofthe pancreas with residual collection. D, MRI abdomen T1-weighted axial image (day 870 after the onset of pancreatitis) showing normal pancreatic tissue in the body and tail region. E, Follow-up CT scan at day 1408 after the onset of pancreatitis showingatrophy of the body and tail region of the pancreas. F, Follow-up CT scan at day 1408 after the onset of pancreatitis; the axialsection at a level inferior to the pancreas shows complete resolution of the necrosis.

Table 1 Comparison in the Three Groups

Characteristic	**Medical Management Group (n = 14)**	**PCD-Alone Group (n = 29)**	**PCD Pancreatic Necrosectomy Group (n = 27)**	***P*[1]**	***P*[2]**
No. patients	14	29	27	-	-
Age in years (Mean SD)	40.7±16	43.5±12	40±12	0.53	0.23
Male:female	1.8:1	1.9:1	2.6:1	0.93	0.31
Etiology (%)					

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Gallstones	7 (50)	6 (21)	9 (33)		
Alcohol abuse	2 (14)	14 (48)	11 (41)		
Gallstones + alcohol abuse Referral after onset of symptoms (days) (mean ± SD)	0 5 (36) 5 ± 3.2	2(7) 7 (24) 13.3 ± 9.8	2(7) 5 (19) 11 ± 9.5	0.005*	0.54
C-reactive protein (mg/L) (mean ± SD)	100.7 ± 125	96 ± 96.3	56.6 ± 59.7	0.3 0.9	0.10 0.10
Hypocalcemia	2 (14)	4 (14)	8(30)	0.9	0.10
Acidosis at admission pH < 7.2	1 (7)	0	5 (19)	0.1	0.01*
Base deficit at admission > 5 mEq/L	5 (36)	4 (14)	13 (48)	0.09	0.005*
Initial APACHE II score (mean SD)	7±5.3	5.97±4.7	10.93±4.5	0.4	0.001 *
CTSI score at admission (mean SD)	6.5±2.6	6.34±2.5	7.85±2.4	0.09	0.03*
APACHE II score at the time of PCD (Mean SD)	6.3±5.6†	7.1±4.8	13.26±4.5	0.5	0.001*
Site of Pancreatic Necrosis					
Head region					
Body ± tail					
Head + body ± tail	1 (7)	11 (38)	6 (22)		
Complete Necrosis	3 (21)	3 (10)	6 (22)		
Extrapancreatic Necrosis	1 (7)	7 (24)	14 (52)	0.1	0.032*

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LAPR	1	6	8		
RAPR	0	0	1		
BAPR	0	0	3		
LAPR + mesocolon	0	1	0		
Less than 30%	5 (36)	3 (10)	4 (14)		**0.1**
30%–50%	5 (36)	12 (40)	2 (7)		
More than 50%	4 (28)	14 (50)	21 (79)	0.90	0.007*
Parenteral Nutrition Before or After Radiological Intervention Number of patients	3 (21.4)	6 (20.6)	15 (55.5)	0.90	0.01*
Number of days (mean ± SD)	1.5 ± 3.6	1.21 ± 2.5	3.7 ± 4.9	—	0.84
Onset of symptoms to surgery interval (days) (mean ± SD)	-	-	46.5 ± 22.4	-	-
1st PCD surgery interval (days) (mean ± SD)	-	-	27.2 ± 22.9	-	-
ICU stay (days) (mean SD)	3.9± 4.8	3.7±5.6	22.7±16.3	0.70	<0.001
Hospital stay (days) (mean SD)	20.14± 9.3	36.7± 23.4	58.6± 20.3	0.004	<0.001*
Mortality					
Disease-specific	1 (7.1)	2 (6.8)	11 (40.7)	0.90	0.007*
Unrelated to				—	—

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disease	0	1 (3.4)	02 (7.4)		
Organ Failure					
Number of organs failed Mean ± SD	0.64 ± 1.0	0.41 ± 0.73	1.67 ± 1.27	0.753	<0.001*
Organ failure				0.56	0.00*
No organ failure	8 (57)	20 (69)	6 (22)		
Single-organ failure		5 (36)	7 (24)	6 (22)	
Onset of Organ Failure					
Organ failure 1st week		3 (50)	1 (11)	6 (28)	0.06	0.9
Organ failure 2nd week		3 (50)	5 (55)	7 (33)		
Organ failure 3rd week		0	2 (22)	4 (19)		
Organ failure 4th week		0	1 (11)	4 (19)	0.18	0.052
Duration of organ failure – mean ± SD (days)		8.8 ± 4.1	13.6 ± 7.7	21.7 ± 10.7	—	0.002*
Respiratory failure		6(43)	7 (24)	17 (63)	0. 21	<0.001*
Ventilator Support (Days) Before or After Radiological Intervention						
Mean ± SD		1.29 ± 3.4	0.80 ± 2.2	2.7 ± 6.9	0.89	0.22
Pleural aspiration/drainage		2 (14)	8 (28)	15 (56)	0.30	0.03*
Renal failure		1 (7)	1 (3)	12 (44)	0.50	<0.001*
Hemodialysis		0	0	4 (15)	—	0.03*
Circulatory failure		0	1 (3)	1 (4)	0.4	0.90
Altered sensorium GCS ≤ 10		1 (7)	0	5 (19)	0.1	0.01*
Infected pancreatic necrosis		1 (7)	25 (86)	27 (100)	<0.001*	0.04*
Unimicrobial		1 (7)	12 (41)	8 (30)	0.02*	0.35
Polymicrobial		0	13 (45)	19 (70)	—	0.054

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Positive bacterial blood culture before or after radiological	0	8 (28)	16 (59)	—	0.02*
intervention				0.005*	0.019*
Escherichia coli	1 (7)	15 (52)	22 (81)		
Pseudomonas	0	8	6	—	0.64
Acinetobacter	0	4	9	—	0.08
Staphylococcus aureus	0	1	6	—	0.034*
Nonfermenting Gram-negative bacilli	0	3	4	—	—
Klebsiella	0	2	4	—	—
Enterococcus	0	2	4	—	—
Enterobacter	0	1	1	—	—
Morganella	0	1	3	—	—
Proteus	0	1	2	—	—
Anaerobes	0	1	0	—	—
Fungal infection	0	6 (21)	10 (37)	0.06	0.17
Positive fungal blood culture before or after radiological intervention	1	0	4 (15)	0.1	0.03*

Upon examining extrapancreatic necrosis, we found that it was considerably more common in individuals undergoing pancreatic necrosectomy (52%) as opposed to those receiving medical management or PCD only. The left anterior pararenal area was the most often affected site by extrapancreatic necrosis. Additionally, we examined the greatest amount of pancreatic necrosis that each of all three groups experienced throughout their stay. The results showed that, in comparison to the PCD-alone group, the surgical group had a considerably larger proportion of patients with more than 50% necrosis (Table 2). The pancreatic necrosectomy group and the PCD-alone group experienced similar delays between the onset of signs and the initial PCD insertion. The duration of the ICU stay and the number of days that PN is needed prior to or during catheter drainage the entire course, and hospital stay were significantly higher in the pancreatic necrosectomy group compared with the PCD-alone group. Disease-specific mortality was significantly higher in the pancreatic necrosectomy group (40.7%) compared with the PCD-alone group (6.8%).

Table 3. Endpoints

Primary Endpoints	**PCD-AloneGroup (n = 29)**	**PCD + Pancreatic (n = 27)**	***P***
Sepsis reversal within 1 week after PCD insertion –	11 (38)	2 (7.4)	0.007*
no. (%)			<0.001*

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Overall sepsis reversal due to PCD alone – no. (%)	27 (93)	08 (30)	
Therapeutic efficacy of PCD alone – no. (%)	27 (93)	0	—
Reversal of organ failure – no. (%)	7/9 (77.7)	4/21 (19)	0.002*
Secondary Endpoints			
Number of PCD catheters per patient	46	48	
Mean±SD	1.59±0.73	1.81±0.92	0.40
Median (range)	1 (1–3)	2 (1–4)	
Mean ± SD	5.8 ± 2.6	4.56 ± 2.72	0.08
Diameter of PCD			
8 Fr	0	1	0.8
10 Fr	43	40	
12 Fr	0	1	
20 Fr	0	1	
24 Fr	2	2	
28 Fr	1	0	
32 Fr	0	3	0.63
Upsizing of PCD			
10 to 12 Fr	3	3	

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12 to 14 Fr	1	1	
20 to 28 Fr (without guidance)	0	1	
PCD insertion under USG guidance	33	22	—
PCD insertion under CT guidance	10	20	—
Large-bore catheter insertion without image guidance	03	06	—
Site of PCD Pancreatic region	25	29	
LPRR	13	16	
RPRR	04	02	
Pelvic region	02	01	
Head of pancreas	02	0	
Right subhepatic region	01	0	
Transgastric PCD insertion	01	01	
PCD Catheter Duration (Days) Mean ± SD	48.4 ± 48.2	27.26 ± 23	0.03*
Total Drain Duration Mean ± SD	48.4 ± 48.2	87.4 ± 65.7§	0.006*
Morbidity due to PCD and Drains Gastrointestinal fistulae – no. (%)	5 (17)†	2 (7)‡	0.266
Bleeding due to drain erosion – no. (%)	1 (3)†	4 (15)‡	0.136

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Mortality due to PCD and Drains	0	0	—
Overall mortality – no. (%)	3 (10)	13 (48)	0.002*
Disease-specific mortality– no. (%)	2 (7)	11 (41)	0.003*
Other Outcome Prolonged pancreatic fistula [PCD/drain duration	4 (14)	6 (22)	0.411
(>90 days)] – no. (%) Pancreatic duct stenting	4 (14)	1 (4)	0.186

Table 4- Details of Pancreatic Necrosectomy Patients

					Time Between	**Time**	**Sepsis**	**Radiological**			
		APACHE	**APACHE II**	**Number**	**Onset of Pancreatitis**	**Between PCD and**	**Reversal With**	**Management Of Necrosis**		**Amount of**	
	Age	**II Score**	**Score at 1st**	**of Organs**	**and PCD**	**Necrosectomy**	**Preoperative**	**and**	**Indication for**	**Necrosis**	**Postoperative**
S. No	**(Years)**	**Initial**	**Intervention**	**Failed**	**(Days)**	**(Days)**	**PCD**	**Collections**	**Surgery**	**(Grams)**	**Outcome**	**Cause of Death**
1	60	9	9	0	22	13	Sepsis reversal	Not successful	Failure to thrive	300	Survived	—
2	27	21	21	3	9	42	Sepsis reversal	Not successful	Failure to thrive	750	Survived	—
3	45	11	11	2	21	32	Sepsis reversal	Not successful	Failure to thrive	100	Survived	—
4	38	6	7	0	4	37	Sepsis	Not	Failure	300	Surviv	—

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							reversal	successful	to thrive		ed	
5	45	8	8	1	29	26	Sepsis reversal	Not successful	Failure to thrive	300	Survived	—
6	61	6	9	0	20	107	Sepsis reversal	Successful	G I bleeding*	<50	Died	Anastomotic leak
7	21	3	7	0	17	45	Sepsis reversal	Successful	Pseudoaneurysm†	50	Died	with MOF ECF, IVC
8	20	15	15	3	19	60	Sepsis reversal	Successful	Bowel obstruction	<50	Died	thrombosis Endotracheal tube
9	28	11	15	3	6	36	No sepsis	Not successful	Ongoing sepsis	600	Survived	block and hypoxia‡ —
10	33	8	11	1	21	49	reversal No sepsis	Not successful	Ongoing sepsis	300	Survived	—
11	45	21	21	5	17	6	reversal No sepsis	Not successful	Persistent/	600	Survived	—
12	37	17	17	3	19	5	reversal No sepsis	Not successful	worsening sepsis Persistent /	500	Survived	—
13	33	14	14	2	13	20	reversal No sepsis	Not successful	Worsening sepsis Ongoing sepsis	500	Survived	—

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14	25	16	16	3	22	5	reversal No sepsis	Not successful	Persistent/	500	Survived	—
15	35	12	16	2	18	12	reversal No sepsis	Not successful	worsening sepsis Ongoing sepsis	150	Survived	—
16	28	10	10	2	10	21	reversal No sepsis	Not successful	Ongoing sepsis	800	Survived	—
17	32	5	5	2	36	17	reversal No sepsis	Not successful	Colon gangrene	500	Survived	—
18	48	9	22	1	18	14	reversal No sepsis	Not successful	Ongoing sepsis	300	Died	TT block and
19	27	15	15	2	14	14	reversal No sepsis	Not successful	Ongoing sepsis	500	Died	hypoxia ↓ Ongoing sepsis,
20	53	13	17	2	24	4	reversal No sepsis	Not successful	Persistent/	250	Died	MOF Persistent/
							reversal		worsening sepsis			worsening sepsis,
21	42	8	12	3	31	11	No sepsis	Not successful	Persistent/	1000	Died	MOF Persistent/
							revers		worsenin			worsenin

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							al		g sepsis			g sepsis, MOF
22	55	14	14	2	38	41	No sepsis reversal	Not successful	Ongoing sepsis	200	Died	Ongoing sepsis, MOF

Endpoints

Examining the reversal of sepsis as one of the goals of PCD insertion, we found that 35 patients (62.5%) (27 in the PCD-alone group and 8 in the surgical group) had sepsis reversal following PCD insertion. In these eight individuals, the grounds for surgery were: small-bowel obstruction and ruptured pseudoaneurysm in one, GI haemorrhage in one, and failure to thrive in five. There was no death directly connected to PCD, and all problems associated with the disease were treated with a straightforward graduated PCD withdrawal.

It was shown that 11 out of 30 patients with organ failure (36.6%) had their organ failure reversed by PCD treatment (Table 2). In 7 of the 11 cases, this resulted in aversion of surgery, whereas mortality in patients with organ failure reversal was 1 out of 11 (9.1%).

On the other hand, we found that of the 19 patients who did not exhibit organ failure reversal, 17 of them had surgery, and 2 of them were unable to have surgery due to hemodynamic instability. Ten out of the 19 patients (52.6%) who did not experience an organ failure reversal died. Ten patients (4 in the PCD-alone group and 6 in the necrosectomy group) developed pancreatic fistulas. The average duration of pancreatic fistulas was 143 83 days (91–310 days) in the necrosectomy cohort and 142 47 days (90–210 days) in the PCD-alone cohort. All patients in the PCD-alone group and one person in the necrosectomy category underwent pancreatic duct stenting.

Pancreatic fistulas did not directly cause any deaths. Within the surgical group, 11 patients (or 40%) experienced disease-specific mortality. In contrast, 1 patient experienced an inadvertent displacement of the endotracheal tube, and another patient experienced a false passage for the tracheostomy tube during the initial adjustment.

One patient in the medically managed group passed away on day eight of the illness because to MOF and systemic inflammatory response syndrome (SIRS). Two of the three patients in the PCD-alone group died as a result of disease-specific mortality brought on by persistent sepsis and MOF. Following receiving an intramuscular injection in the gluteal region towards the end of their illness, one patient passed away from necrotizing myositis and MOF.

This patient had otherwise achieved sepsis control and the necrotic cavity was obliterated. The microbe found growing in the region of myositis was *Staphylococcus*, whereas in the peripancreatic region, *E. coli* was isolated.

Discussion

Following the publication of the PANTER study5 protocol in 2006, this investigation was carried out. Although the PANTER research[6,7] and our investigation have similar basic designs, there are several significant variations in the procedure that we believe should be noted up front. Despite being prospective, our study lacks randomization, in contrast to the PANTER study8. Every SAP patient who saw us during the trial period was assigned to the step-up approach. We made this decision in part due to our extensive prior experience with open necrosectomy, where the surgical death rate remained extremely high.[9]

Additionally, we believed that we had not been making the most of the effectiveness of PCDs, which were only being used as a bridge to surgery prior to the start of the trial, based on our prior experience. As a result, we intended to use PCDs for a longer period of time and raise our threshold for open necrosectomy. At this point, our community considered that we would be capable to have better outcomes if we could use saline irrigation in a PCD catheter and also increase the size or implant more catheters.

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Another significant distinction from the PANTER study[8] is that necrosectomy was carried out using an open technique as a step-up strategy after PCD proved futile, as opposed to a minimally invasive one. As was previously indicated, in cases of pancreatic and peri-pancreatic necrosis as well as when the necrosis extended into the paracolic regions, we used large-volume saline irrigation with a Y-connector. Depending on the situation, we utilised two or more catheters; one was employed for fluid input and the others for debris outflow. The purpose of this strategy is to replicate the results of an open necrosectomy with a controlled lesser-sac lavage.

The step-up strategy has been criticised for only applying to certain cases where the necrosis is liquid and has little debris. Regardless of the contents' type, we used the step-up strategy in our research and inserted PCD into every necrotic cavity anytime step 2 on the ladder of the step-up technique was recommended. In actuality, six of the twelve patients who had total pancreatic necrosis were treated without surgery. This demonstrates that the step-up method can be used to handle even total necrosis nonoperatively.

The outcomes of our research were compared to those of four seminal studies published in the literature: Freeny's study, which was the first to report on PCD; the PANTER study, which was the first to employ the step-up approach; the multicenter prospective study conducted by Horvath et al.,[13] which assessed the safety and effectiveness of video-assisted retroperitoneal debridement for infected pancreatic collections; and the multicenter research conducted by a Dutch pancreatitis study group,[10] which was a prospective descriptive cohort investigation consisting of 639 patients treating necrotizing pancreatitis. These four studies have a sizable patient population, even if there are other small series[11] where writers have employed the step-up strategy with varying degrees of effectiveness. The institution of PCD in Freeny's study[12] showed sepsis reversal in 74% of the patients, and this compares well with our resultsof 62.5%, though it is at a lower level than observed in Freeny's study. One major reason that we can think of for this is that the time until presentation for a large majority of our patients is, on average, 10 days, where we have little control on the initial resuscitation.

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