

## Introduction

Pancreatic fluid collections (PFCs) are a common complication of necrotizing acute pancreatitis (NAP) and are a significant cause of morbidity and mortality. Multiple intervention approaches are utilized in a step-up fashion for management of symptomatic PFC in patients with NAP. The aim of this study is to analyze the short- and long-term clinical outcomes in these patients treated endoscopically, percutaneously or surgically.

## Methods and Materials

This retrospective cohort study was conducted in a large tertiary center. Patients with NAP complicated by PFC were selected for possible inclusion. Short term (<90 days) and long term (>90days) clinical outcomes including mortality was compared between three groups; first group defined as patients who underwent endoscopic ultrasound guided drainage alone or in combination with percutaneous drainage, a second group are patients who underwent surgery only and third group are patients who underwent percutaneous drainage alone.

## Results

A total of 637 patients with NAP complicated by PFC on imaging were included, of those; 318 patients underwent an intervention for management of PFC from 2009 to 2019 with a median follow up time of 17 months. Group 1 had 229 patients, group 2 had 30 patients and group 3 had 59 patients. Group 3 patients had higher BMI (32, p<0.05). Patients in group 2 and 3 had longer hospital stays (18 and 19 days, respectively, p<0.05), more likely to be transferred to ICU (33% and 24%, respectively, p<0.05) and had severe pancreatitis at the time of presentation (57% and 59%, respectively, p<0.05). Patients in group 1 were more likely to present with recurrent episodes of AP (74%, p<0.05). Alcoholic pancreatitis was the most common etiology overall and in in group 1 39%, p<0.05. Infected collection was the most common indication for drainage overall, and in group 3 (64%, p<0.05). Transfer to ICU was lower in group 1 (14%, p<0.05). 90-day mortality was lower in the group 1 with 5.2% (P<0.05). No difference was noted on long term complications between the different groups.

Characteristic	Overall, N = 318 <sup>1</sup>	Intervention Modality			p-value <sup>2</sup>
		Endoscopy alone or IR/PERC, N = 229	Surgery Alone, N = 30	IR/PERC Alone, N = 59	
Body Mass Index, Median (IQR)	26 (23, 32)	26 (23, 30)	27 (23, 32)	32 (26, 36)	<0.001
Transferred to ICU, n (%)	65 (20)	32 (14)	11 (37)	22 (37)	<0.001
Length of Hospital Stay, Median (IQR)	10 (6, 22)	8 (5, 18)	18 (10, 29)	19 (11, 38)	<0.001
Severe Acute Pancreatitis on Presentation, n (%)	103 (32)	51 (22)	17 (57)	35 (59)	<0.001
Occurrence, n (%)					<0.001
First	98 (31)	58 (25)	12 (40)	28 (47)	
Recurrent	216 (68)	170 (74)	17 (57)	29 (49)	
Chronic	4 (1.3)	1 (0.4)	1 (3.3)	2 (3.4)	
Alcoholic Pancreatitis, n (%)	104 (33)	90 (39)	4 (13)	10 (17)	<0.001
Multiple Pancreatic and Peripancreatic Fluid Collections, n (%)	180 (57)	129 (57)	10 (33)	41 (69)	0.005
PFC size on CT scan, Median (IQR)	89 (56, 128)	78 (50, 112)	120 (89, 138)	126 (82, 158)	<0.001
Retroperitoneal PFC with Pelvic Extension, n (%)	55 (17)	29 (13)	6 (20)	20 (34)	<0.001
Drain Indication: Abdominal Pain, n (%)	89 (28)	71 (31)	13 (43)	5 (8.5)	<0.001
Drain Indication: Infected Collection, n (%)	102 (32)	50 (22)	14 (47)	38 (64)	<0.001
Drain Indication: Gastric Outlet Obstruction, n (%)	35 (11)	32 (14)	1 (3.3)	2 (3.4)	0.023
90-Day Mortality, n (%)	26 (8.2)	12 (5.2)	3 (10)	11 (19)	0.004

<sup>1</sup> Median (IQR); n (%)  
<sup>2</sup> Kruskal-Wallis rank sum test; Pearson's Chi-squared test

## Long Term Complications

Characteristic	Overall, N = 318 <sup>1</sup>	Intervention Modality			p-value <sup>2</sup>
		Endoscopy alone or IR/PERC, N = 229 <sup>1</sup>	Surgery Alone, N = 30 <sup>1</sup>	IR/PERC Alone, N = 59 <sup>1</sup>	
<b>Pancreatic Fistula</b>					0.10
Internal Fistula	31 (86%)	20 (83%)	1 (50%)	10 (100%)	
External Fistula	5 (14%)	4 (17%)	1 (50%)	0 (0%)	
<b>New Chronic Pancreatitis</b>	36 (12%)	28 (12%)	2 (6.9%)	6 (11%)	0.8
<b>Chronic Abdominal Pain</b>	25 (7.9%)	19 (8.3%)	2 (6.7%)	4 (6.8%)	>0.9
<b>New-Onset Diabetes</b>	50 (16%)	32 (14%)	7 (23%)	11 (19%)	0.3
<b>Exocrine Insufficiency</b>	17 (5.3%)	11 (4.8%)	2 (6.7%)	4 (6.8%)	0.6
<b>Pancreatic Cancer</b>	5 (1.6%)	4 (1.7%)	0 (0%)	1 (1.7%)	>0.9
<b>Duodenal Ulceration</b>	16 (5.0%)	14 (6.1%)	1 (3.3%)	1 (1.7%)	0.5
<b>Abdominal Thrombosis</b>	78 (25%)	63 (28%)	3 (10%)	12 (20%)	0.079
<b>Abdominal Pseudoaneurysm</b>	21 (6.6%)	18 (7.9%)	0 (0%)	3 (5.1%)	0.3
<b>Biliary Tract Stricture</b>	67 (21%)	53 (23%)	4 (13%)	10 (17%)	0.3

<sup>1</sup> n (%)  
<sup>2</sup> Fisher's exact test; Pearson's Chi-squared test

## Discussion

- Surgical open necrosectomy used to be the cornerstone of treatment of PFCs, but with it came high degree of worsening organ failure, poor clinical outcomes, and mortality.
- Now, minimally invasive strategies are the mainstay of treatment, and provide lower risk of perioperative stress, organ failure and long-term complications leading to better outcomes and improved survival rates.
- Minimally invasive strategies can be classified into (open, radiologic, endoscopic, combined interventions or other).
- Endoscopic drainage or radiologically guided percutaneous drainage are the first line of treatment, followed by endoscopic or laparoscopic minimally invasive surgical necrosectomy.
- Major complications are uncommon but do happen, and each modality carries its own risk profile, this study is aimed at evaluating and detailing the different complications, both short and long term.
- Multiple studies showed that noninvasive drainage techniques have shorter hospital stays and better physical and mental health outcomes, most notably a randomized clinical trial (RCT) done comparing endoscopic and surgical interventions to draining PFCs, showing significantly lower length of hospital stay compared to the surgical approach, consistent with the findings of our study, as a combined intervention approach having shorter hospital stays.
- Regarding mortality, it differs drastically depending on the AP severity, PFC type and maturity and most importantly the intervention modality used. Surgical approaches carry the highest risk of death, followed by less invasive modalities with endoscopic drainage having the lowest risk. This is consistent with the results of our data showing significantly lower mortality rates with endoscopic interventions compared to the others.

## Discussion

- Splanchnic vein thrombosis (SVT), defined as a thrombus formation in the splenic, portal and/or superior mesenteric vein, can be found incidentally on imaging or contribute primarily to the patient presentation. It thought to be a factor in increasing portal pressure development of varices and subsequent variceal bleeding, and treatment with anticoagulation remains controversial, but should be initiated when clot extends further or if there is a compromise to the bowel blood supply. Nonetheless, treating the underlying necrotic collection remains the most effective path and associated with lower rates of complications. Our study shows similar rates of SVT are higher yet not statistically significant in the combined intervention group.
- Pancreatic fistulae (PF) characterized by pancreatic fluid leak due to disruption of pancreatic duct, mostly iatrogenic, less commonly caused by non-iatrogenic causes (acute and chronic pancreatitis). When plotted against other groups, intervention using percutaneous drainage as an independent factor results in almost two times more PFs. This can be explained by the fact that externally placed draining catheters used in percutaneous interventions can erode into the intestinal wall causing pancreatico-enteric fistulas and into the skin causing external PFs.
- Diabetes diagnosed after an episode of AP s defined as postpancreatitis diabetes (DM). A meta-analysis of 24 studies of AP shows an incidence of newly diagnosed diabetes of 15-24% after the AP episode, this increased to 40% after 60 months of follow up, 70% of those patients required insulin treatment permanently. Our study shows similar rates of DM between different intervention groups, without difference in terms of modality of intervention, all consistent with data in the literature.

## Conclusions

Endoscopic management alone or in combination with percutaneous drainage of symptomatic PFC in patients with necrotizing acute pancreatitis lead to shorter hospital stay, lower mortality when compared to percutaneous drainage alone or surgery. There was no difference in the long-term complications including chronic pancreatitis, EPI, new onset DM and chronic abdominal pain across these groups. Multidisciplinary approach is recommended in NAP.

## Contact

Yazan Abu Omar, MD  
Cleveland Clinic Foundation  
Email: abuomay@ccf.org  
Phone: 216-644-8676