

# Strategy for Effective Percutaneous Drainage of Pancreatic Collections: Results on 121 Patients

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**There is a lack of technical guidelines for image-guided percutaneous drainage (IGPD) of pancreatic fluid collections (PFCs). To fill that void, we present a strategy and guidelines for systematic IGPD for effective PFCs evacuation.**

*Methods:* Institutional Review Board (IRB)-approved study of 121 pancreatitis patients with symptomatic PFCs that underwent IGPD. IGPD strategy aimed at evacuation of the PFCs compartments using vigorous catheter drainage and manipulations. PFCs resolution and patients' outcome were measured.

*Results:* Pancreatitis pathogenesis and etiology included: necrotizing, 79 patients (alcoholic, 40; biliary, 20; hyperlipidemia, 8; other, 11); traumatic, 32 patients; and chronic ductal, 10 patients (pseudocysts). An ipsilateral retroperitoneal access was used for pararenal spaces PFCs (61, 50% patients), a transabdominal IGPD approach for anterior PFCs (49 patients, 41%), an intercostal/subcostal access for left subphrenic PFCs (22 patients, 18%), and a transgastric drainage route for retrogastric PFCs (9 patients, 7%). Table 1 lists the site of the pancreatic fluid collections and number and size of the catheter(s) used for IGPD of the PFCs in the 121 patients. Fifty-seven (47%) patients had positive cultures PFCs. Of these, 24 (20%) had polymicrobial infections, and 18 (15%) had fungal infections. There were 20 (11%) patients with multi-compartment drainage. PFCs resolution occurred in 102 (84%) patients. PFCs recurrence was treated by surgery (four patients) or IGPD (one patient). Pancreatic fistulas closed, except in one patient. Nine patients (7%) experienced multiorgan failure/death; 5 (4%) were lost to follow-up.

*Conclusion:* In our series, the strategy of vigorous compartmental drainage coupled with consistent catheter irrigation and patient follow-up allowed us to achieve resolution of most PFCs.

## INTRODUCTION

Management of pancreatic fluid collections (PFCs) complicating acute pancreatitis has evolved in the past two decades. Advances in critical care, as well as effective alternative minimally invasive techniques, were pivotal for the transition from major operations to minimally invasive PFCs evacuation.<sup>1-3</sup> Currently, there is ongoing progressive experience substituting surgical exploratory laparotomy for debridement and drainage and moving towards minimally invasive image-guided percutaneous drainage (IGPD)<sup>4-6</sup> or endoscopic drainage.<sup>7,8</sup> Despite several articles that appeared in the radiologic literature in the 1990s stating the efficacy of the percutaneous approach for evacuation of PFCs, IGPD utilization lagged behind surgical drainage.<sup>2</sup>

Arguments made against the effectiveness of IGPD included the infection of sterile PFCs from catheter insertion, lack of reliable patient follow-up, and differing results from published series.<sup>2</sup>

Since the landmark publication of the Patients with Acute Necrotising Pancreatitis (PANTER) trial, the surgical literature has acknowledged the usefulness of the IGPD approach for evacuation of pancreatic collections complicating pancreatitis.<sup>4,9</sup> An editorial publication has assertively realized that technical guidelines for IGPD of PFCs are lacking and has suggested the need for them.<sup>6</sup> In response to this request, we present our experience using a multidisciplinary systematic strategy and guidelines for effective IGPD of PFCs. A comparison of these results with published up-to-date surgical and endoscopic drainage is discussed.

**Table 1:** Site of the pancreatic fluid collections, number and size of the catheter(s) used for the image-guided percutaneous drainage of the PFC in the 121 patients.

PFC Locations*	No. of Patients	No. of Patients (No. of Catheters)	Mean Catheter Size (Fr)
1	49	4 (1), 25 (2), 8 (3), 7 (4), 4 (5), 1 (7)	12.5
2	35	15 (1), 10 (2), 9 (3), 1 (5)	10.7
3	14	3 (1), 9 (2), 2 (3)	11.1
4	6	1 (1), 4 (2), 1 (3)	10.7
1+2	8	2 (1), 2 (2), 1 (3), 1 (5), 1 (6), 1 (8)	11.1
1+3	2	1 (3), 1 (5)	11.2
1+4	2	1 (1), 1 (7)	10
1+2+3	1	1 (4)	10
2+3	4	1 (1), 1 (2), 1 (3), 1 (4)	13
2+3+4	1	1 (2)	10

PFC = Pancreatic fluid collection

\*List of the PFC locations includes: 1=Retroperitoneal approach for Pararenal space PFC drainage; 2=Transabdominal approach for anterior space PFC drainage; 3=Intercostal/subcostal approach for left subphrenic PFC drainage; 4=Transgastric approach for retrogastric PFC drainage.

## MATERIALS AND METHODS

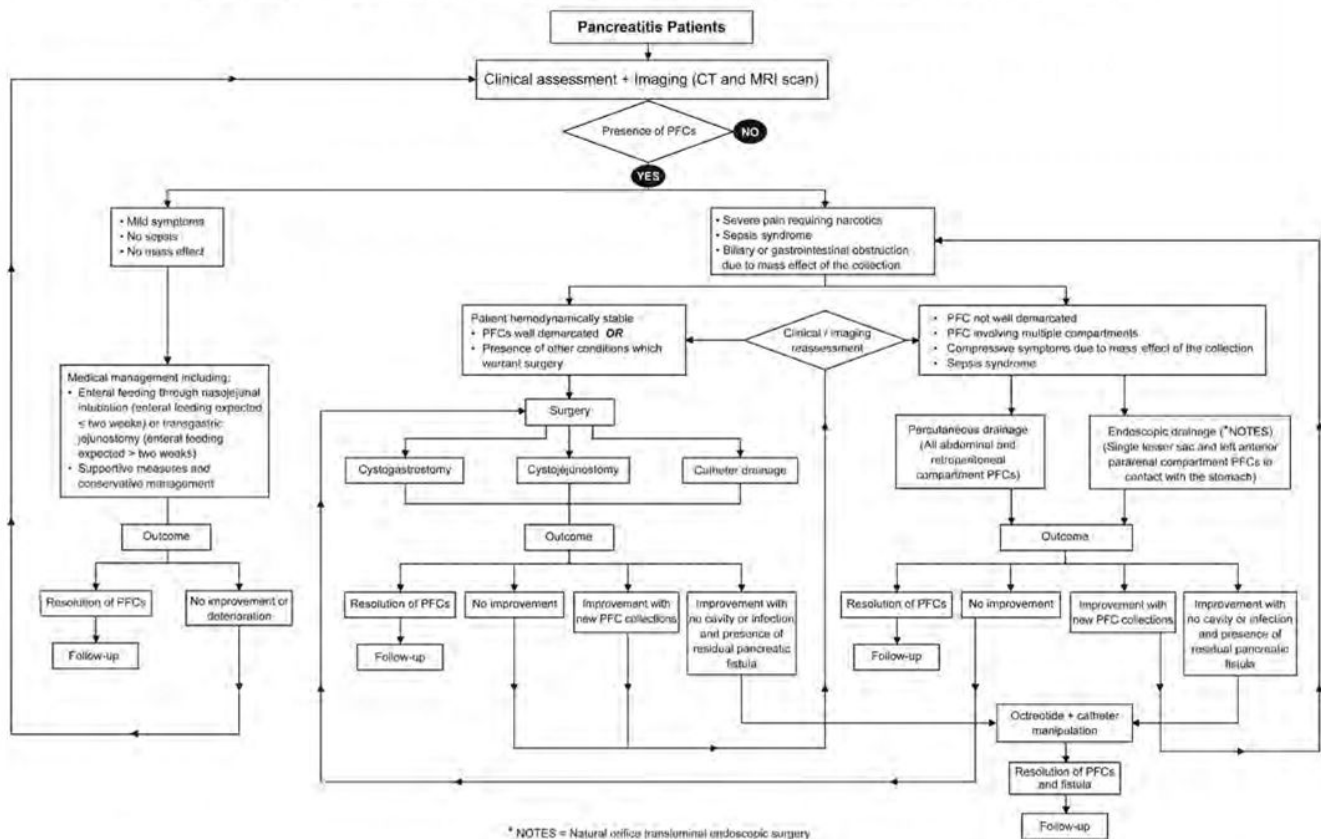
This is a retrospective IRB-approved protocol performed from February 1999 to October 2010, which included patients that were assessed and admitted with the clinical impression of pancreatitis in our institute. Patients that required intensive care unit (ICU) management were classified as having severe pancreatitis, while patients that were managed as regular inpatients were classified as suffering a moderate form of pancreatitis. Patient inclusion criteria involved acute pancreatitis patients that had a fluid collection diagnosed by imaging with an elevated concentration of pancreatic enzymes content confirmed by percutaneous aspiration/drainage. Included patients were clinically assessed and had routine laboratory tests (complete blood cell count and metabolic panel, including serum amylase and lipase concentrations). Additional laboratory studies were requested, depending on the severity of the patients' conditions. Blood samples for culture and sensitivity were obtained on patients with fever on admission. Initial imaging evaluation comprised an ultrasound (US) of the liver and gallbladder and a contrast-enhanced computer tomography (CECT) scan of the abdomen and pelvis with intravenous and gastrointestinal contrast, unless there were contraindications for the use of intravenous contrast. On follow-up, magnetic resonance cholangiopancreatography (MRCP) was used on selected patients to evaluate the presence of gallstones and the integrity of the pancreatic duct.

PFCs were characterized by their pathogenesis using the LSU HPB group PFCs pathogenesis classification (modified from D'Egidio et al.)<sup>10</sup> and divided into necrotizing, ductal, and traumatic PFCs. Necrotizing PFCs resulted from the

local effect of activated pancreatic enzymes on the retroperitoneal spaces. They were characterized by a lack of enhancement on CECT of the pancreas, peripancreatic tissues, and additional retroperitoneal compartments, depending on the extent of the process. Traumatic PFCs were the consequence of accidental trauma, surgical or endoscopic interventions to the pancreas, and resultant PFCs. Ductal PFCs occur in patients with a history of alcoholism who develop PFCs that become symptomatic because of large size, infection, or intracavitary hemorrhage.

A multidisciplinary HPB team composed of surgeons, gastroenterologists, radiologists, and interventionists evaluated and decided the management approach for each patient. Patient selection criteria for surgical or IGPD were the presence of a symptomatic PFC by CT and the symptoms. Abdominal pain, sepsis, and the mass effect of the PFC compressing adjacent organs within the involved compartment(s), as well as the possibility of causing abdominal compartment syndrome, were considered indications for PFCs evacuation. PFCs with well demarcated margins by CECT in stable patients were selected for surgical drainage. A percutaneous drainage approach was chosen for ill-defined margins PFCs involving single or multiple compartments following the management algorithm summarized in Figure 1. Post-drainage follow-up included daily rounds for routine patient evaluation and catheter management. Drainage volume/24 hours was measured. Catheters were irrigated daily, and catheter sinograms were systematically performed to evaluate the residual PFC cavity and the presence of a fistula. Enteral nutrition was instituted as early as feasible via nasojejunal intubation (when enteral feeding expected to be necessary for less than two weeks)

Approach Algorithm for Surgical and Image-guided Percutaneous Drainage (IGPD) of Pancreatic Fluid Collections (PFCs)



**Figure 1:** Algorithm for surgical drainage and image-guided percutaneous drainage (IGPD) of pancreatic fluid collections (PFCs).

or transgastric jejunostomy (for patients expected to have enteral feedings beyond two weeks).

### Catheter management

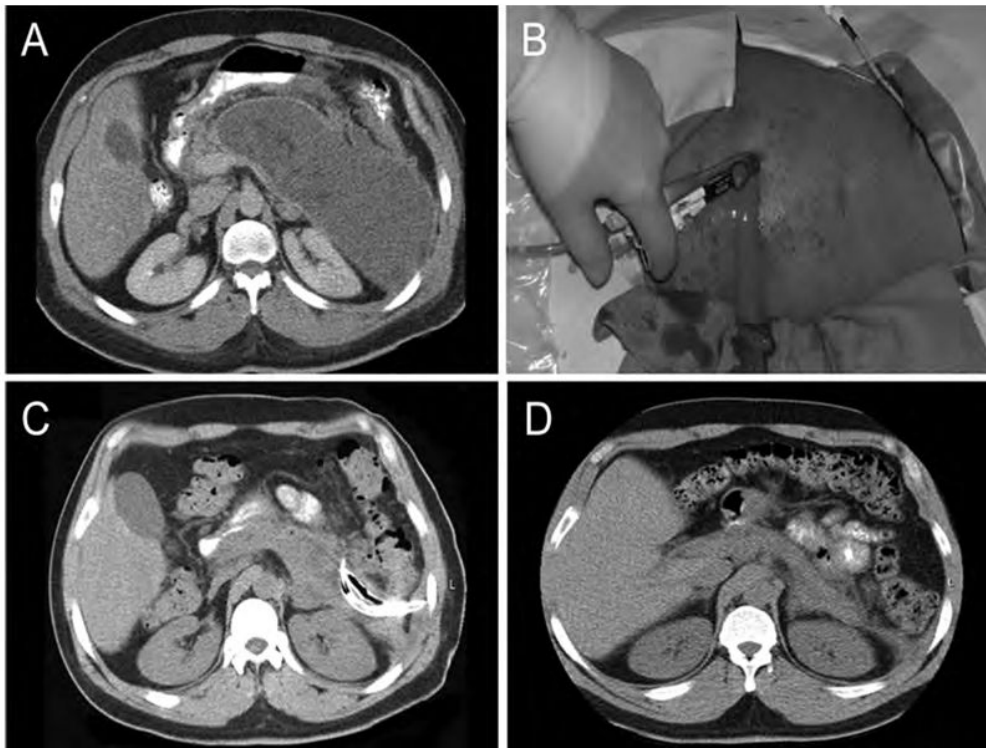
The 24-hour volume drained was measured. Catheters were irrigated daily on morning rounds. Catheters were aspirated to check for residual undrained fluid before injection of the irrigant solution. Dakin's solution 0.125% was used initially for irrigation. If the patient had a single drainage catheter within the PFC, 10-20 mL aliquots of the irrigant solution were injected and aspirated using a three-way stopcock. If the patient had two drainage catheters within the PFC, the smaller size catheter was used for irrigation while the large size catheter was used for aspiration of the injected irrigant. PFCs were irrigated until the irrigant recovered was clear. Patients that had viscous or necrotic debris PFCs content required two or three daily irrigations. The decision to reposition, upsize, or downsize the drainage catheters or to perform percutaneous necrosectomy (either fluoroscopy or videoendoscopy-guided) emanated from clinical and imaging evaluation of the patients' evolution. Dakin's solution was replaced by normal saline if the patient had PFC pancreatic duct or enteral communication diagnosed by

catheter sinogram. Catheter revision followed evaluation of the patients' clinical condition and IGPD imaging evaluation regarding PFCs evacuation. The frequency of these revision sessions for removal, repositioning, or inserting additional drainage catheters was tailored to each specific patient. Patients with extensive and evolving PFCs required more revision sessions and catheter manipulations for complete evacuation of complex, debris containing collections.

Routine imaging follow-up was performed about a week to 10 days after initial drainage to evaluate IGPD effectiveness and residual fluid/debris within the PFCs. CT imaging was followed by revision of the drainage catheters to optimize/confirm evacuation of the PFCs and search for pancreatic duct or enteral fistula. The latter was achieved by means of catheter sinograms (tube checks). The injection of contrast through the drainage catheters provided information regarding the size and content of the residual collection cavity and the presence or absence of a fistula.

### Criteria for patient hospital discharge

Patients were discharged with drainage catheters when nutritional support was established and catheter irrigation could be carried out at home. Typically, patients were fed



**Figure 2:** Access to left anterior pararenal space on a patient with infected pancreatic necrosis complicating alcoholic pancreatitis -

A. Extensive necrosis occupying the left anterior pararenal space;

B. Initial drainage performed using two 24 FR catheters for evacuation and a 10.2 FR locking pigtail catheter for irrigation;

C. Post-catheter drainage;

D. Follow-up at three months and after drainage catheter removal.

a low fat diet by mouth and specifically trained relatives or healthcare workers performed catheter irrigation. This management continued in between hospital visits at the HPB outpatient clinic for clinical and imaging evaluation of the PFCs drainage until catheter removal.

#### Criteria for catheter removal

Catheters were removed when patients had no sepsis, the fluid collection cavity had resolved by CT and catheter sinogram, drainage output was less than 10 mL per day, and there was no pancreatic or enteral fistula.

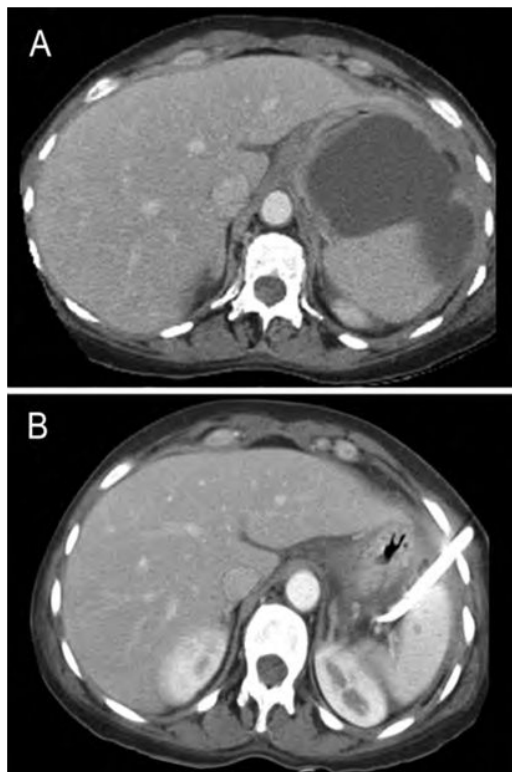
Long-term follow-up was carried out at the HPB outpatient clinic for one month, three months, six months, and at least one year after catheter removal. Asymptomatic patients had a CT of the abdomen and pelvis with gastrointestinal and intravenous contrast, which was performed one-month post-catheter removal. If there was resolution of the PFCs in the one-month follow-up, consideration for no further imaging until discharge from the HPB clinic was discussed with the patient. A CT of the abdomen and pelvis with gastrointestinal and intravenous contrast was performed at anytime within the one-year follow-up period in cases where the patient had symptoms that could be related to recurrence of the PFCs. Patients with residual renal insufficiency had their follow-up CT studies only with gastrointestinal contrast. Pediatric patients were followed up with abdominal ultrasound to search for the presence of a residual PFC. Patients that had recurrence of the PFCs had their management decided in the same multidisciplinary fashion as when they had the original PFC treated.

Parameters measured for evaluation of the results from IGPD of PFCs in this series were: a) resolution of the PFC without surgery, b) duration of catheterization, c) IGPD failure and recurrence management, and d) morbidity and mortality.

## RESULTS

During the study period, 2,738 patients with diagnosis of pancreatitis were admitted at our institution. Of these, there were 149 patients with symptomatic pancreatic fluid collections that were evaluated by the HPB team for drainage. Of the 149 patients evaluated in a multidisciplinary fashion by the HPB team, there were 28 patients deemed eligible for surgery who had PFCs with well-defined borders (pseudocysts), while 121 patients had IGPD. None of the 28 patients that underwent surgical drainage had severe pancreatitis. The operations performed were cysto-gastrostomy, 11 patients; cysto-jejunostomy, 13 patients; and cyst aspiration and biopsy, four patients. There were three postoperative complications: recurrence of the pancreatic fluid collection, intraabdominal infection, and fistula; one patient each, respectively.

Of the 121 patients that underwent IGPD of their PFCs, there were 77 (64%) males and 44 (36%) females. The mean age of the patients was 49 years (range 3-78 years). Of these, the pancreatitis was necrotizing in 79 (65%) patients, traumatic in 32 (26%) patients, and ductal in 10 (8%) patients. The pancreatitis causes of the 79 patients with necrotizing PFCs were: alcohol, 40 patients; biliary, 20 patients; hyper-



**Figure 3:** Intercostal access for left subphrenic pancreatic pseudocyst. A. Pre-drainage; B. Post-drainage evacuation.

lipidemia, eight patients; vasculitis, three patients (systemic lupus erythematosus, two; scleroderma, one); medications/AIDS, 2 patients; post-renal transplant, one patient; and unknown, five patients. The causes of pancreatitis for the 32 patients with traumatic PFCs were: surgery, 23 patients; abdominal trauma, eight patients; and endoscopy, one patient. Alcoholism was the cause of pancreatitis on the 10 patients with ductal PFCs (pseudocysts).

Fifty-eight patients had severe pancreatitis requiring critical care in the ICU, including resuscitation actions and intravenous broad-spectrum antibiotics. They all had clinical and imaging findings of pancreatic necrosis. Respiratory assistance ranged from nasal oxygen for less severe cases to endotracheal intubation and machine ventilation support for severe respiratory insufficiency and tracheostomy for protracted cases. The development of acute renal insufficiency necessitated hemodialysis, while life threatening sepsis patients underwent plasmapheresis for the removal of bacterial toxins.

IGPD was successful in achieving PFCs resolution without additional surgery in 102 (84 %) of 121 patients. PFCs recurred in five (4%) patients. There were nine (7%) patients that died, and five (4%) were lost to follow-up. Table 1 lists the site of the pancreatic fluid collections and number and size of the catheter(s) used for IGPD of the PFCs in the 121 patients. The ipsilateral retroperitoneal route was used in 61 (50%) patients for drainage of right or left pararenal space

PFCs (Figure 2A-D). A transabdominal anterior drainage path was used in 49 (41%) patients with PFCs amenable to this approach. In 22 (18 %) patients with left subphrenic PFCs, an intercostal (Figure 3A,B) or subcostal access was utilized for catheter insertion.

Transgastric drainage was performed in nine (7%) patients for retrogastric PFCs evacuation (Figure 4A-C). Initial drainage of multiple compartments was necessary on 20 (11%) patients with PFCs involving several abdominal or retroperitoneal spaces (Figure 5A and B). Single drainage catheter achieved evacuation of the PFCs in 25 (20%) patients, while 96 (80%) patients had multiple catheters inserted initially for PFCs drainage. The characteristics of the fluid aspirated ranged from slightly turbid to frankly purulent, necrotic, or hemorrhagic. Fifty-seven (47%) patients had positive cultures PFCs. Of these, 24 (20%) had polymicrobial infections, and 18 (15%) had fungal infections. Average initial PFCs evacuation was 558 mL (range, 10 to 5,000 mL). Patients with extensive and evolving PFCs required several catheter revision sessions and catheter manipulations for complete evacuation of complex, debris containing collections. Average duration of catheterization was 51.57 days (range, 4 to 237 days; median, 36 days). Catheters were needed for less than 30 days in 45 patients, while 15 patients had their drainage catheters inserted for more than 100 days.

Failure of IGPD to resolve the PFCs occurred in five patients that developed PFCs recurrence after catheter removal. Of these, three patients underwent surgical cystogastrostomy (Figure 4). Initial IGPD was not able to control sepsis in one patient that had severe pancreatitis and duodenal perforation post-endoscopic retrograde cholangiopancreatography (ERCP) and duodenal biopsy. He had multiple small intraabdominal and retroperitoneal abscesses that necessitated laparotomy for extensive drainage revision and a colostomy. Postoperatively, further IGPDs were needed to resolve persistent duodenal and colonic fistula. The remaining patient had chronic alcoholic pancreatitis that developed a large retentional pseudocyst evacuated by IGPD. She suffered another bout of acute alcoholic pancreatitis and recurrence. She was treated successfully by repeated IGPD and discontinuation of ethanol intake.

Our series complications were disease process and catheter-related. There were no major procedure-related IGPD of PFCs complications. Patients had their corresponding systemic inflammatory response according to the severity of their disease process. We observed hypovolemic shock, sepsis (50 patients), diabetes mellitus (36 patients), respiratory distress (26 patients), renal insufficiency (15 patients), and malnutrition (34 patients) in our patients during their course of admission. Distal biliary obstruction with cholangitis and duodenal obstruction occurred on patients with longstanding active pancreatitis. These complications resolved with biliary drainage and observation. Deep venous thrombosis and intracranial hypertension were life-threatening conditions which were managed with inferior vena cava filter insertion and specific measures for decreasing intracranial

pressure, respectively.

Minor catheter-related complications included pain and leakage at the catheter insertion site, catheter blockage, and accidental catheter dislodgement. Intercostal placement of the catheters and large diameter catheters caused definite patient discomfort. Catheter-related pain was controlled with oral pain medication. Large diameter catheters did not cause clinically significant pain when placed through the abdominal wall. Catheter drainage blockage occurred more commonly with single 10 FR catheters evacuating fluid with particles. This situation occurred early after catheter insertion and when catheter irrigation was not effective. This condition was remediated by catheter exchange for larger diameter catheters (20-24 FR) and placement of an additional 10 FR catheter for irrigation. Accidental catheter dislodgement occurred mostly in ambulatory patients, despite securing the drainage catheters with one or more skin sutures. Depending on the evolution of each patient's condition, either the catheters were reinserted or the patient was observed for the appearance of recurrence.

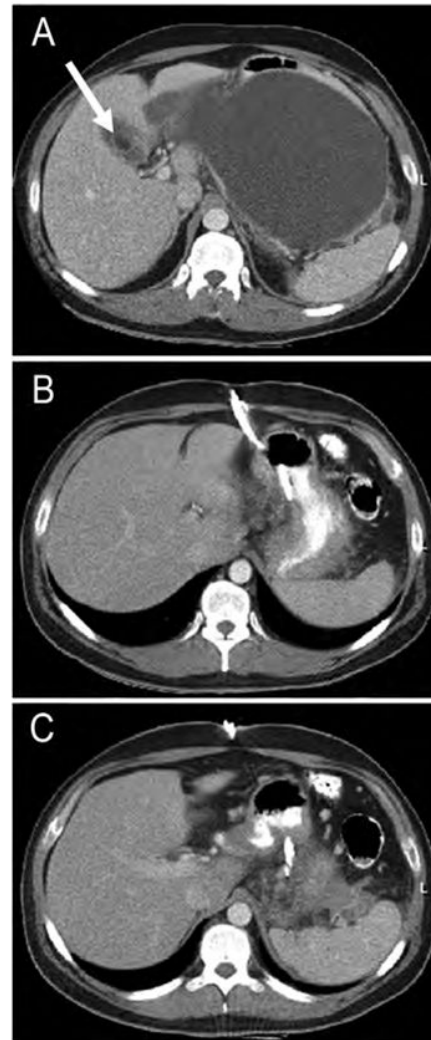
The controlled injection of diluted contrast through the drainage catheter (catheter sinogram) revealed communications with the pancreatic duct or the gastrointestinal tract from the stomach, duodenum, small bowel, and colon. Fistula management included downsizing the catheter and subcutaneous administration of octreotide. All of these fistulas closed, except on one patient with a pancreatic-cutaneous fistula who had end-stage renal disease and severe malnutrition. The patient had a protracted course and died with the fistula patent.

The series mortality was 7% (nine patients). Multiorgan failure was the cause of death in seven (6%) patients. One patient died of pulmonary embolism, despite having an IVC filter in place. Increased intracranial pressure causing transtentorial herniation was the cause of death of the remaining patient. There were no postprocedure deaths from IGPD, and we had one case of death in the group that required additional intra-abdominal operations.

## DISCUSSION

The results of our study support a systematic process for optimization of percutaneous drainage of PFCs. The decision making for selecting percutaneous drainage was multidisciplinary and required focused HPB team members' interaction. An evaluation of the PFCs imaging characterization as fluid-like or complex and which abdominal compartments were involved was the initial step of the drainage strategy. This assessment was aimed at evacuation of the fluid and tissue within the compartment where the PFCs were located. The uses of multiple and large diameter catheters, consistent vigorous catheter irrigation, and patient follow-up were successful in achieving resolution of most PFCs.

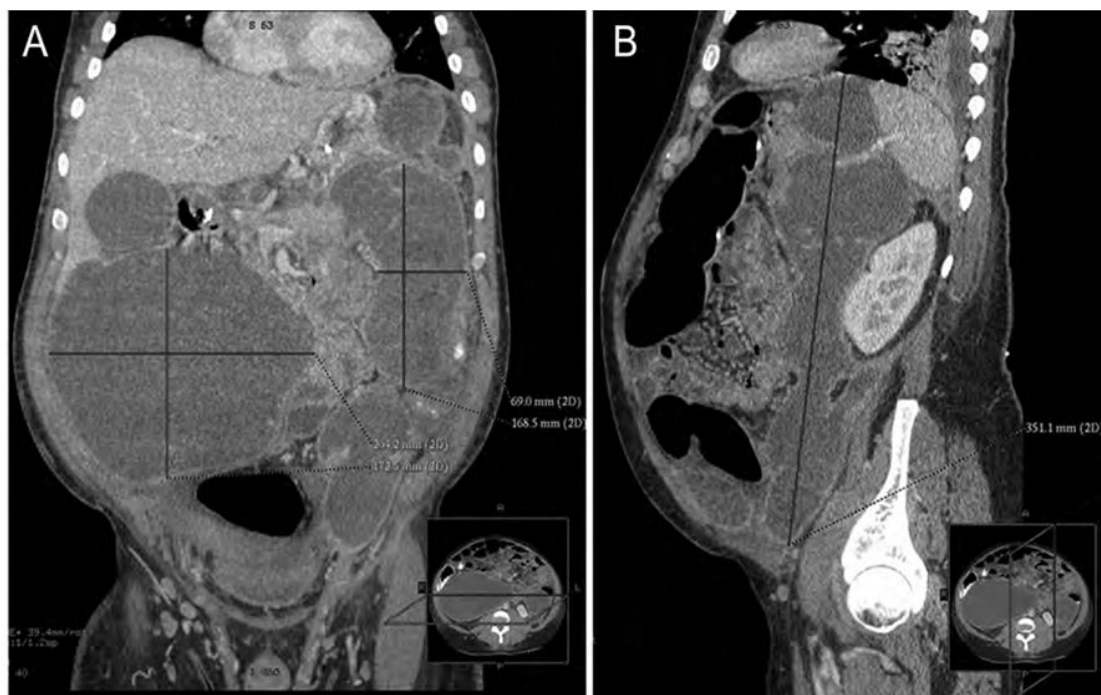
Successful outcome of IGPD of PFCs depends on a demanding post-drainage patient and catheter management. After the catheters have been inserted, patients require daily bedside evaluation and optimizing drainages, as well as



**Figure 4:** A, B, C - Transgastric access to left anterior pararenal space PFC on a patient with gallstone pancreatitis. The arrow in Figure 4A points to the gall stone.

consideration for surgical drainage. The presence of necrotic debris within the fluid drained makes complete evacuation of PFCs challenging.<sup>11</sup> Retained residual necrotic material within the collections sustains the sepsis. Necrosectomy through percutaneous catheter drainage skin holes can be accomplished with catheter maneuvers, baskets, and videoendoscopy.<sup>12</sup> It is our experience that large diameter catheters ( $\geq 20$  FR) and percutaneous manipulations are the key to necrotic tissue removal from PFCs.<sup>2,12</sup> Multiple drainage catheter skin holes are enlarged to 30 FR to allow the laparoscope and instruments to be inserted within the PFCs cavity for videoendoscopy-guided percutaneous necrosectomy. While this is a persuasive technique and patient tolerance is excellent, similar results can be achieved with the deployment of less technological resources.<sup>2</sup> Interestingly enough, despite evidence stating the usefulness of large bore catheters for percutaneous necrosectomy, there is a recent publication questioning such value.<sup>13</sup>

Critical care management progress in acute pancreatitis-related complications, as well as effective alternative minimally invasive techniques, were pivotal for the transition



**Figure 5:** Coronal (A) and sagittal (B) image reconstructions of a patient with extensive necrotizing pancreatitis involving both retroperitoneal compartments. The necrosis was successfully evacuated with bilateral percutaneous drainage catheters.

from major operations to minimally invasive PFCs evacuation.<sup>16</sup> Excellent critical care is a must for maintaining the patients long enough for them to recover from the initial dramatic aggression of severe pancreatitis. Management of PFCs has truly evolved from a condition requiring multiple surgeries to having PFCs biologic resolution without drainage in a large number of pancreatitis patients treated with current assertive supportive care.<sup>1</sup>

In spite of the definite value of IGPD for PFCs, prolonged duration of catheterization and repeated follow-up imaging and drainage revisions are the shortcomings of the technique. Both of these situations are related to the severity of the pancreatitis.<sup>16</sup> Tolerance of carrying a drainage catheter with its collection bag varies from patient to patient. When the PFC cavity has disappeared and a residual pancreatocutaneous fistula ensues, subcutaneous octreotide administration is of value in decreasing drainage output and accelerating the resolution of the fistula.<sup>17</sup> Alternative endoscopic procedures are applicable options that leave no external sequel of the PFC drainage.<sup>18-20</sup> To date, anatomical conditions remain as one of the few limitations to this concealed, safe, and effective drainage for PFCs.<sup>19</sup>

Pancreatitis patients' series comparison is challenging because of PFCs nomenclature and severity of the disease categorization. After four major consensus meetings from Marseille (1963 and 1984), Cambridge (1983), and Atlanta (1992), PFCs nomenclature remains a controversial topic.<sup>2</sup> We use the general term "pancreatic fluid collections" (PFCs) for collections with elevated pancreatic enzymes content that develop in acute pancreatitis patients to avoid confusion. Additionally, we characterized pancreatic fluid collections by their pathogenesis. Such pathogenesis characterization in

necrotizing, traumatic, and ductal PFCs is straightforward and does not aim at conflicting with current pancreatitis collections terminology. In the series presented, patients that required critical care management in the ICU for survival were considered as having severe pancreatitis. APACHE II, SOFA, or other severity scores were not available in all patients to measure pancreatitis severity in this retrospective study on patients managed prior to electronic health record implementation at our institution. Ultimately, the decision-making process to evacuate PFCs emanates from clinical and imaging evaluation of each patient's condition and is not affected by pancreatitis nomenclature and disease severity.

IGPD, in our experience, was successful in achieving PFCs resolution in more than 84% of the cases, even though 48% of our patients had severe pancreatitis requiring ICU admission. The recurrence rate of the 4% and the mortality of 7% seem to be quite comparable to other reports in the literature.<sup>4,5,7,8</sup> A Dutch pancreatic study group reported a significantly lower chance of new onset multi-organ failure in the pancreatitis patient with PFCs that were managed by the percutaneous drainage (step-up approach) compared with the open necrosectomy approach (12% versus 40%). However, they had similar mortality rates in the two approaches (19% versus 16%). Although it is not practical to compare the result of the reported series, we believe that the key to our improved outcome compared to the previous reports<sup>4</sup> lies in the vigorous approach of our interventional radiology group in draining the PFCs and the fact that we have not been hesitant to use very large catheters when required (24-30 Fr).

A systematic approach to percutaneous drainage is advantageous for IGPD of PFCs because of the peculiar

situation that patients who develop PFCs are as diverse as PFCs nomenclature.<sup>2,6,7,10,14</sup> This diversity encompasses a wide range of management complexity from PFCs being dealt with in the ward after a simple small diameter catheter percutaneous drainage to the intensive care unit-managed patients having surgical drainage in cases of IGPD failure. Traumatic PFCs have a straightforward response to IGPD, even in patients in whom the pancreatic duct was completely transected.<sup>15</sup> Conversely, post-necrotic PFCs may challenge IGPD because they comprise several compartments, and it is difficult to remove necrotic debris from the collection cavity. It is in these particular patients that the described strategy of robust drainage and manipulations applied to the compartments involved allow for debridement to effectively evacuate complex PFCs.

Correlation of the clinical scenario with up-to-date imaging findings is useful for multidisciplinary indication and selection of PFCs drainage. Such management depends on the patient's general condition, the severity of the pancreatitis, and the local resources available at the institution where the patient is being treated. In the opinion of our HPB team, it is prudent to consider transferring patients with severe pancreatitis to centers experienced in their management and treatment.

Integrated with multidisciplinary and critical care management with appropriate sepsis treatment and nutritional support, the proposed systematic technical IGPD guidelines are effective for resolution of PFCs with minimal morbidity and no mortality directly related to the procedure. The combination of IGPD with endoscopic drainage (NOTES) of PFCs emerges as a promising alternative treatment that may reduce the number of drainage revisions and shorten the duration of catheterization.<sup>20</sup>

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