




Feasibility and Safety of Bedside Percutaneous Catheter Drainage of Necrotic Pancreatic Fluid Collections in the Intensive Care Unit

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Abstract

Purpose Critically ill patients with acute pancreatitis (AP) require intensive care unit (ICU) admission. The management of pancreatic fluid collections (PFCs) in this group is challenging. We aimed to evaluate the feasibility and safety of bedside percutaneous ultrasound (USG)-guided interventions in necrotic PFC in ICU patients.

Methods This retrospective study comprised consecutive patients with AP in the ICU who underwent bedside USG-guided interventions for necrotic PFC. Indications for intervention, technical success, clinical success, and complications were recorded. The site, number, and size of catheters were recorded. Clinical outcomes were assessed.

Results Thirty-three patients (mean age, 38.1 years, 15 females) were included. All patients had nonresolving organ failure and were on mechanical ventilation. The mean pain to percutaneous catheter drainage (PCD) interval was 42.2 days (range, 7–167 days). All the procedures were technically successful, and none of the patients required shifting to the interventional radiology suite for computed tomography guidance. PCD was clinically successful in 40% of the patients. There were no major complications. The mean length of hospital stay and ICU stay was 35 days (range, 6–69 days) and 13 days (range, 1–63 days), respectively. Six (17.1%) patients underwent necrosectomy. Sixteen (45.7%) patients died in the hospital.

Conclusion USG-guided bedside PCD can be performed safely with high technical success in the ICU setting.

Keywords

- ▶ drainage
- ▶ collections
- ▶ catheter
- ▶ acute necrotizing pancreatitis
- ▶ ultrasound

Introduction

Drainage forms an important part of the step-up approach for the management of symptomatic necrotic pancreatic fluid collections (PFCs) in acute pancreatitis (AP).¹ The

options for drainage are endoscopic and percutaneous. While endoscopic drainage is being increasingly utilized, percutaneous catheter drainage (PCD) remains a critical part of the management.^{2,3} A subgroup of critically ill patients

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with AP requires mechanical ventilation in the intensive care unit (ICU). The management of PFCs in this group is challenging. Endoscopic drainage of pancreatic collections requires the encapsulation of the collection and most gastroenterologists use fluoroscopy while placing endoscopic cystogastrostomy stents. PCD is also technically difficult as all the collections must be accessed under ultrasound (USG) guidance only. The patient mobility and cooperation are limited, and adequate position is not possible. In this study, we assessed the feasibility and safety of PCD of the necrotic PFC in the AP patients on mechanical ventilation in the ICU who cannot be shifted to the interventional radiology suite.

Materials and Methods

Design and Setting

This was a retrospective study performed at a tertiary care referral center, where a large number of patients with AP are managed. The study was approved by the local ethics committee. Consecutive patients with necrotizing AP who underwent bedside USG-guided of the necrotic PFC in the ICU from January 2018 to December 2019 were included. Patients who underwent bedside drainage of ascites or pleural effusion without drainage of PFC were excluded. For this study, interventions of PFC included either percutaneous catheter insertions or upgradations. Written informed consent was obtained from the kin of the patient prior to each intervention.

Baseline Evaluation

The demographic characteristics, etiology, and severity of AP, and number and type of organ failure (OF) were recorded.⁴ Modified computed tomography (CT) severity index (mCTSI) was calculated based on the CT scan performed between 3 and 7 days from the onset of symptoms. However, patients who had acute kidney injury (AKI) and required upfront ICU admission did not undergo CT scans. In these patients, a thorough baseline bedside USG evaluation was performed prior to the drainage. The sites of the PFC were categorized as lesser sac, right and left paracolic gutter, mesenteric, perihaptic, perisplenic, and pelvic.³ The collections were classified as acute necrotic collections (ANCs) if ≤ 4 weeks from the onset of pain and walled-off necrosis (WON) if > 4 weeks from the onset of pain.⁴

Treatment Protocol

All patients received intravenous fluid resuscitation, oxygen support, pain relief, nutritional, and organ support as per standard recommendations. Antibiotics were given to patients with suspected infections (extrapancreatic or infected pancreatic necrosis, latter suspected based on presence of gas on CT and confirmed by culture of aspirate at the time of PCD). A step-up approach was adopted for management of PFC. This approach comprises initial conservative management followed by drainage (PCD or endoscopic). Patients who did not respond to PCD were evaluated for minimally invasive surgical or endoscopic necrosectomy.

Percutaneous Interventions

Percutaneous interventions were categorized as initial insertion (insertion of a new catheter) or upgradation (upsizing of an existing catheter) that were performed in the ICU. The interval between onset of pain and the percutaneous intervention was recorded. Indication of catheter insertion and upgradation were recorded. Site and size of collection (that was drained), number and size of catheters were recorded. Additionally, interventions performed during non-ICU hospital stay were also recorded.

All the percutaneous interventions were performed under USG guidance at patients' bedside in the ICU. Interventions were performed by interventional radiologists with 2 to 7 years' experience in nonvascular abdominal interventions. Preprocedure evaluation of the platelet count and prothrombin time (and index) was done. If the platelet count was $< 50,000/\mu\text{L}$ and prothrombin time index $< 50\%$ correction was done using blood products. Proper asepsis was achieved with local application of 10% betadine solution. The site was draped with a sterile sheet. After local instillation of the skin entry site with 2% injection lignocaine, the collection was accessed with an 18G needle under real-time USG guidance. A 0.035-inch stiff guidewire (Amplatz, Cook) was inserted and needle was removed. Stiff fascial dilators were used for dilatation of the soft tissue tract. Finally, 10 to 14F pigtail or malecot catheter was inserted (**► Figs. 1 and 2**). All the steps were performed under real-time USG guidance. Skin sutures were used to secure the catheter in place. Catheter was flushed with 50 to 100 mL of saline daily to maintain patency.

Catheter upgradations were done after confirming the position of catheter tip within the collection on a recent CT or a bedside USG. The existent catheter was removed over a stiff guidewire placed into the collection. Over this guidewire a larger catheter was placed.

Catheter-related complications were divided into minor and major as per the Society of Interventional Radiology guidelines.

Outcomes

Clinical success was defined as resolution of collection (and discharge from the hospital) with PCD without the need for necrosectomy.

Patients were assessed and reviewed during their ICU stay and were subsequently followed up till their discharge from the hospital or in-hospital demise. Patient outcome was assessed in terms of length of hospital stay, length of ICU stay, surgery, and in-hospital mortality.

Results

During the study period, 260 patients with AP underwent PCD of PFC. Thirty-three patients met the inclusion criteria and were finally evaluated. The mean age was 39.8 years (range, 17–68 years). There were 18 (54.5%) males and 15 (45.5%) females. Most common etiology of AP was gallstone disease ($n = 17$) followed by alcohol abuse ($n = 11$). The mean mCTSI score (33 patients had CT evaluation) was 9.54 (range, 6–10). Nineteen (54.3%) patients had ANC and 14 (42.4%)

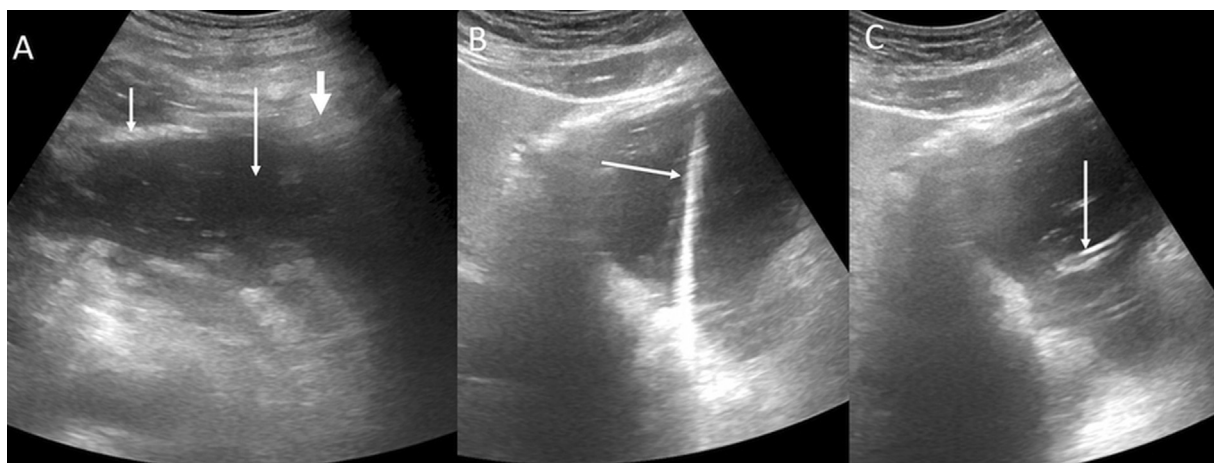


Fig. 1 (A) Ultrasound image shows a collection in the lesser sac (arrow). Note the stomach (short arrow) covering part of the collection. Thick arrow points to the omentum. (B) The collection was accessed via transperitoneal route with guidewire in place (arrow). (C) A catheter has been placed within the collection (arrow).

patients had WON. All patients had lesser sac collections. Extension to right and left pararenal spaces was seen in 4 and 8 patients, respectively. Right and left paracolic gutter extensions were seen in 1 and 6 patients, respectively. Ascites was present in 26 patients. The indications of catheter insertion and upgradations were infected necrosis ($n=10$), nonresolving OF ($n=30$), and intra-abdominal hypertension ($n=7$). Acute lung injury (ALI) and AKI at the time of percutaneous intervention were present in 27 (81.2%) and 6 (18.2%) patients, respectively. Both ALI and AKI were present in 5 (15.3%) patients. Few patients have more than one indication of percutaneous intervention.

Baseline characteristics have been summarized in ►Table 1.

The mean interval between the onset on pain and insertion of PCD was 42.2 days (range, 7–167 days). Most common site of collection was lesser sac in 28 (84.8%) cases. Multiple

collections were seen in 8 patients. The mean maximum dimension of collection was 10.2 cm (range, 6–20 cm).

All the procedures were technically successful under USG guidance. None of the patients required shifting to the interventional radiology suite for CT guidance. Catheter insertion was performed in 21 (63.7%) patients. Catheter insertion and upgradation was performed in 12 (36.3%) patients. Catheter insertion at more than one site was performed in 7 (21.2%) patients. The routes for catheter insertion were transperitoneal ($n=31$), retroperitoneal ($n=4$), transgastric ($n=3$), and transhepatic ($n=2$). Mean initial and maximum catheter size (comprising insertions and upgradation) were 13.3F (range, 10–18F) and 16.2F (range, 10–28F), respectively. PCD parameters have been summarized in ►Table 2.

PCD was clinically successfully in 40% of the patients. There was no significant difference in the clinical success

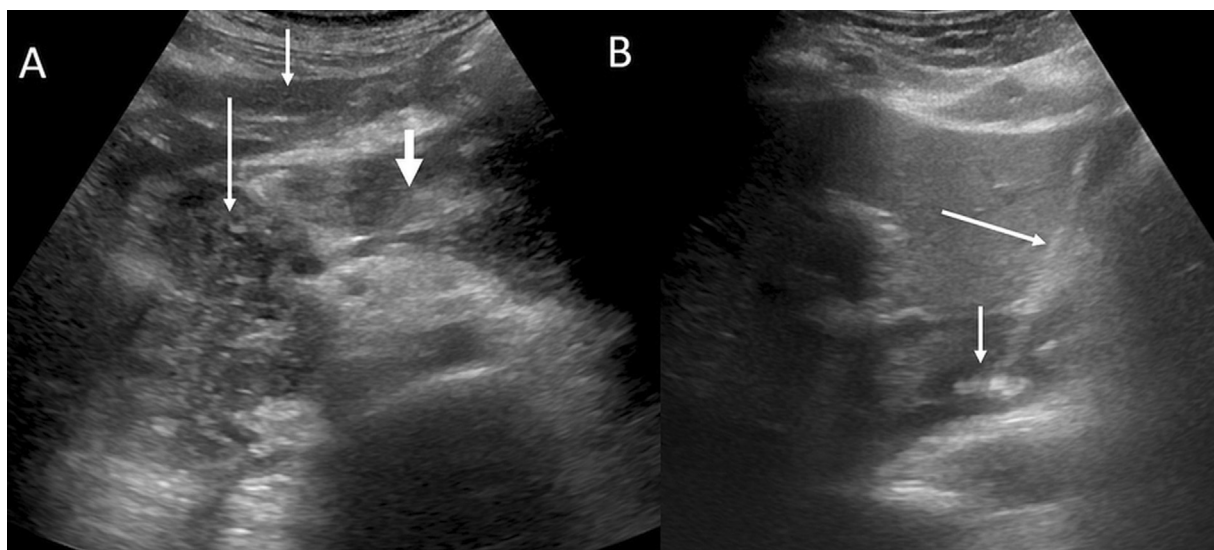


Fig. 2 (A) Ultrasound image shows a necrotic collection adjacent to the head of pancreas (arrow). This collection is posterior to the left lobe of liver (short arrow). Also note the enlarged pancreas with extensive necrosis (thick arrow). (B) The collection was accessed via the left lobe of liver (arrow). Note the residual collection with catheter in situ (short arrow).

Table 1 Baseline characteristics of patients (n = 33)

| Parameters | Result |
|--------------------------------------|---------------------------|
| Age | 39.8 y (range, 17–68 y) |
| Males/females | 18/15 |
| Etiology | |
| Gallstones | 17 (51.1%) |
| Alcohol abuse | 11 (33.3%) |
| Post-ERCP | 1 (3%) |
| Traumatic | 1 (3%) |
| Others | 3 (9.1%) |
| Severity | |
| Mean modified CTSI | 9.54 (range, 6–10) |
| Organ failure | |
| ALI | 27 (81.2%) |
| AKI | 6 (18.2%) |
| Both | 5 (15.1%) |
| Characteristics of collection | |
| ANC/WON | 18/15 |
| Mean maximum dimension of collection | 10.2 cm (range, 6–20 cm). |

Abbreviations: AKI, acute kidney injury; ALI, acute lung injury; ANC, acute necrotic collection; CTSI, computed tomography severity index; ERCP, endoscopic retrograde cholangiopancreatography; WON, walled-off necrosis.

between ANC and WON. Complications of percutaneous interventions in the ICU included mild bleeding that required no additional treatment (n = 2), pericatheter leakage (n = 6), and catheter slippage (n = 2). There were no major complications.

The mean duration of length of hospital stay and length of ICU stay was 35 days (range, 6–69 days) and 13 days (range, 1–63 days), respectively. Six (18.1%) patients underwent necrosectomy. Sixteen (48.5%) patients died in the hospital. Clinical outcomes have been summarized in ► **Table 2**.

Discussion

We evaluated the feasibility and safety of bedside USG-guided percutaneous interventions in patients with necrotizing AP in the ICU setting. Collections at all the sites could be successfully drained under USG guidance. None of the patient had to be shifted to the interventional radiology suite for CT guidance. No major complications were encountered. PCD is an established method of drainage of PFC. Several studies have reported high technical success of PCD. Clinical success is variable and depends on the severity of AP and the comorbidities.^{5–12} Recent series using PCD proactively have reported better clinical outcomes. Patients with AP who are on mechanical ventilation pose specific challenges in the management. Besides the issues of organ support and monitoring of vital body functions, drainage of symptomatic PFCs

Table 2 PCD parameters and outcomes

| Parameters | Result |
|---|-------------------------|
| Indications | |
| Persistent SIRS | 13 (39.4%) |
| Nonresolving or new onset organ failure | 14 (42.4%) |
| Infected necrosis | 6 (18.2%) |
| Percutaneous intervention | |
| Insertion | 21 (63.6%) |
| Insertion + upgradation | 12 (36.4%) |
| Site of percutaneous intervention | |
| Peripancreatic | 27 (81.8%) |
| Left paracolic gutter | 2 (6.1%) |
| Mesenteric | 2 (6.1%) |
| Perisplenic | 1 (3%) |
| Subhepatic | 1 (3%) |
| Routes of drainage ^a | |
| Transperitoneal | 29 (87.9%) |
| Retroperitoneal | 4 (12.1%) |
| Transgastric | 3 (9.1%) |
| Transhepatic | 2 (6.1%) |
| Mean initial catheter size (F) | 13.3 F (range, 10–18 F) |
| Mean maximum catheter size (F) | 16.2 F (range, 10–28 F) |
| Complications | |
| Bleeding | 2 (6.1%) |
| Pericatheter leakage | 6 (18.2%) |
| Catheter slippage | 3 (9.1%) |
| Outcomes | |
| Surgery | 6 (18.2%) |
| Mortality | 16 (48.5%) |
| Mean length of hospital stay | 35 d (range, 6–69) |
| Mean length of ICU stay | 13 d (range, 1–63) |

Abbreviations: ICU, intensive care unit; PCD, percutaneous catheter drainage; SIRS, systemic inflammatory response syndrome.

^aAlso includes 5 patients who underwent interventions of multiple collections.

comprise a significant challenge. Shifting these patients for CT guidance for drainage may not be feasible. Even if it is done, there is significant risk of decompensation. Interventions at patients' bedside in the ICU itself without shifting the patients are most desirable. However, all bedside percutaneous interventions must be performed under USG guidance. While this is less technically demanding for superficial collections, for example, large collections in the paracolic gutter or those in the perihepatic location, collections at other sites including lesser sac may be difficult to access on USG.

Few studies have evaluated the percutaneous USG-guided drainage of PFC,¹³⁻¹⁸ though none has been explicitly performed in the ICU setting. In a study by Wroński et al, 24 percutaneous catheters were inserted under USG guidance in 18 patients with infected necrosis.¹³ Retroperitoneal access was obtained through the left lumbar approach in 13 patients. Right retroperitoneal and transperitoneal access was achieved in 3 and 4 patients, respectively. Transperitoneal access was done through the gastrocolic ligament in 4 patients. Successful treatment with PCD alone was achieved in 6 patients only. Major complications occurred in 5 patients that required surgery. Three patients had leakage of necrotic contents in the peritoneal cavity while two had bleeding. In contrast to the study by Wroński et al, we did not encounter any major complication in our study. In a study by Ai et al comprising 32 patients with severe AP and necrotic PFC, 19 patients underwent surgical debridement.¹⁴ Rest of the patients ($n = 13$) underwent USG-guided PCD. While 26.3% patients died in the surgery group, there was no mortality in the patients who underwent PCD. The baseline sepsis and OF were not significantly different in the two groups. No major complications were reported. Though, our results regarding the safety are similar to the study by Ai et al, mortality was high in our group. This difference is explained by the fact that our patients had OF while only one patient had OF in the study by Ai et al. Additionally, Ai et al had three patients with pseudocysts. In our study, all patients had necrotic collections. Navalho et al reported USG-guided drainage of infected PFC in 30 critically ill patients.¹⁵ However, additional CT guidance was required in 20% of the patients. None of the patients in our series required CT guidance. In a study by Delattre et al 59 patients with severe AP under USG-guided PCD of 48 infected and 11 sterile PFC.¹⁶ Clinical success with PCD alone was achieved in 19 (32%) of the patients. Rest of the patients underwent necrosectomy, out of which 8 patients died. Three patients developed gastrointestinal fistula. Two had bleeding from the catheter site which the authors reported as secondary due to the gastrointestinal fistula. We encountered bleeding in two patients. However, it stopped spontaneously without additional intervention in both the patients. We did not encounter inadvertent gastrointestinal injury, although we did not follow the patients who survived after their discharge from the hospital. Gastrointestinal fistulae have usually been reported as a late complication in the course of AP.^{19,20} In another study, comprising 286 patients, 51 patients underwent USG-guided PCD as the initial intervention. The clinical success was achieved in 69% (35/51) of the patients.¹⁸ The mortality rate was 6%. OF was present in 35% of the patients at the time of PCD. Multiple OF was present in 14% of the patients. Compared with this study, all patients in our study had OF. Thus, higher mortality in our study can be explained due to the critical illness of the patients secondary to OF.

The transperitoneal approach was used more frequently compared with retroperitoneal approach due to the ease of drainage via this route as positioning the patients who are on multiple organ support for drainage via retroperitoneal route is challenging.²¹ We performed PCD through transgastric

approach in three patients. This approach is not frequently utilized. Sugimoto et al utilized transgastric PCD in 54% of the patients.²² However, they performed all their interventions under CT guidance and performed repeat CT scans for confirming catheter position and upsizing. They did not report complication specific to transgastric approach.

The drainage of pancreatic collections in the ANC stage is more challenging compared with the WON. This is due to the absence of a well-formed capsule around the collection as well as the presence of greater degree of solid components. However, a large study did not report any significant differences in the outcomes between the two groups.¹⁰ External pancreatic fistula was more common in patients undergoing PCD for WON compared with ANC. Another study reported the safety and efficacy of early interventions in AP. The mean pain to PCD interval was 14.3 ± 2.4 days (range, 8–18 days).²³

There were a few limitations to our study. The sample size was small. The follow-up of patients was limited to the hospital course only. Data regarding recurrence of collections and need for repeated interventions as well as mortality after discharge from the hospital could have added strength to our observations. Although, we could perform drainage of all the collections under USG guidance, it must be acknowledged that USG-guided drainage of deeper collections is challenging. There is a learning curve and drainage may require transgastric and transhepatic routes (as were utilized in this study). As patients with necrotizing pancreatitis have collections involving multiple sites, USG-guided drainage of easily accessible collections may be done in ICU. This may control systemic inflammatory response syndrome and reduce intra-abdominal pressures. CT-guided drainage of the deeper collections may be done later once the patient stabilizes.

Conclusion

In conclusion, percutaneous USG bedside interventions can be performed safely with high technical success in the sickest patients with necrotizing AP who are admitted in the ICU and are receiving mechanical ventilation.

Ethical Approval

This was a retrospective study performed at a tertiary care referral center, where a large number of patients with AP are managed. The study was approved by the local ethics committee.

Conflict of interest

None declared.

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