—Original Article—

Comparison of endoscopic *versus* percutaneous drainage of symptomatic pancreatic necrosis in the early (<4 weeks) phase of illness

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ABSTRACT

Background and Objective: Pancreatic fluid collections in early phase of illness <4 weeks after onset of acute pancreatitis (AP) are usually treated with percutaneous drainage (PCD). There is a paucity of data comparing early (<4 weeks) endoscopic transluminal drainage (ETD) with PCD in patients with symptomatic pancreatic necrosis (PN). The objective of this study is to compare the safety and efficacy of early ETD with PCD in patients with symptomatic PN. **Patients and Methods:** Retrospective analysis of database of patients with symptomatic PN treated early (<4 weeks of onset of AP) with either ETD (encapsulated wall on EUS) or PCD. **Results:** Twenty-three patients (19 M; mean age: 36.1 years) were treated with ETD and 41 patients (29 M; mean age: 39.6 years) were treated with PCD, respectively. ETD and PCD were done 24.2 ± 2.3 and 24.2 ± 2.0 days after onset of AP, respectively ($P = 0.84$). In the ETD group, 35% of patients were treated with self-expanding metallic stents and 48% of patients required direct endoscopic necrosectomy. In the PCD group, 74% of patients were treated with multiple catheters and 91% of patients with either saline or streptokinase irrigation. As compared to the ETD group, patients in the PCD group took longer time for resolution (61.9 ± 22.9 days *vs.* 30.9 ± 5.6 days; $P < 0.00001$), increased need for surgery (30% *vs*. 4%; $P = 0.01$), and frequency of formation of external pancreatic fistula (EPF) (22% *vs*. nil; $P = 0.02$). **Conclusions:** ETD of PN in early phase of illness is associated with a shorter duration for resolution and infrequent need of salvage surgery compared to PCD. EPF formation is a significant adverse event with PCD.

Key words: acute pancreatitis, endosonography, pancreatic necrosis, stent, walled off necrosis

INTRODUCTION

Acute pancreatitis (AP) is a disorder characterized by an acute inflammatory insult to the pancreatic–peripancreatic tissue resulting in its necrosis in few patients along with systemic injury and organ failures.[1,2] Organ failure and presence of PN especially infected necrosis have been

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shown to be important determinants of prognosis in AP.[2,3] Despite all efforts, morbidity and mortality associated with acute necrotizing pancreatitis (ANP), especially infected PN, remains high.[4-6]

Development of a mature encapsulating wall differentiates an acute necrotic collection (ANC) from a walled-off necrosis (WON), a process that usually takes around 4 weeks.[7] These infected necrotic collections have been traditionally treated with surgical necrosectomy. However, open surgical procedures in these patients were associated with increased morbidity and mortality. Over the last few years, there has been a paradigm shift in their management to minimally invasive interventional radiologic, laparoscopic, and endoscopic procedures.[8] Because of being walled off and having clear demarcation of necrotic from viable tissue, WON are easier to drain as compared to ANC. WON can be drained radiologically, endoscopically, or surgically. As compared to radiological or surgical drainage, endoscopic transluminal drainage (ETD) has been shown to be associated with significantly better clinical success, lower reintervention rates, lower mortality, risk of major organ failure, and adverse events.[9] The superiority of ETD in the treatment of WON has been confirmed by randomized controlled studies as well as systematic reviews.[10-15]

In contrast to patients with WON, patients with ANC are usually not treated endoscopically because of lack of well-formed wall as well as concern with draining a predominantly solid necrotic collection. ETD in absence of well-formed wall can result in pneumoperitoneum or pneumoretroperitoneum and consequent infective complications.[16] Therefore, percutaneous step-up approach, *i.e.*, percutaneous drainage (PCD) followed by minimally invasive surgical necrosectomy if required, is the currently accepted management strategy for infected pancreatic fluid collections in the first 4 weeks of illness and ETD has been traditionally recommended for collections beyond 4 weeks of illness.[13,17,18]

However, the cutoff of 4 weeks is arbitrary and necrotic collections may get walled off completely or partially <4 weeks of onset of illness.[19] Hence, pancreatic fluid collections that have been completely or partially walled off before 4 weeks can also be treated endoscopically. Few recently published studies have demonstrated the safety and efficacy of ETD during early phase (<4 weeks) of ANP, thus expanding the indications of endoscopic intervention in ANP.[19-22] However, the experience with ETD in early phase is still limited, there are concerns about increased frequency of adverse effects, and its results have not been compared with the conventional step-up PCD approach. In this retrospective study, we report the safety and efficacy of early ETD (<4 week after onset) of ANP with PCD in patients with symptomatic PN.

PATIENTS AND METHODS

The study was conducted at a tertiary care center in Northern India. A retrospective analysis of prospectively maintained database of patients with ANP over the last 5 years was conducted. All the patients who underwent an early drainage (within 4 weeks of the disease onset) for the management of PN, either via PCD or ETD, were identified and included in the final analysis. The diagnosis of ANP was based on revised Atlanta classification.[7] Patients underwent ETD only if there was some semblance of a wall in PN on EUS or cross-sectional imaging. During the same period, patients who underwent PCD in the early phase of illness and had partially or completely encapsulating wall were included for comparative analysis. Informed consent was obtained from all the patients prior to the procedures.

Patients were subjected to a drainage procedure (PCD or ETD) in the presence of a symptomatic pancreatic fluid collection that failed to respond to conservative management. The indications for drainage included persistent sepsis (persistent, worsening or new onset organ failure, fever, and leukocytosis) or persistent symptoms due to pain, biliary obstruction, and gastric outlet obstruction. During the initial study period, all the pancreatic fluid collections in the first 4 weeks of illness were treated with PCD. Subsequently, we discovered that few fluid collections were getting walled off before 4 weeks cutoff and these necrotic collections were preferably treated with ETD.

Drainage procedures

Endoscopic transluminal drainage

All ETD procedures were performed by a single experienced endoscopist under conscious sedation. The EUS examination was conducted with a linear scanning echoendoscope (EG-3870 UTK linear echoendoscope, Pentax Inc, Tokyo, Japan or UCT180 linear echoendoscope, Olympus Optical Co. Ltd., Tokyo, Japan). Only the patients in whom semblance of an encapsulating wall, as assessed by the endoscopist on EUS, were considered for further treatment with

ETD. On EUS, the size of the PN and percentage of solid debris were noted prior to puncture. The echogenic material present in the PN was suggestive of necrotic debris. Using an approximate visual judgment of the endoscopist, the amount of solid necrotic debris was done as a percentage of total size of collection. Using EUS, color Doppler, and fluoroscopy guidance, the optimal site of transluminal puncture was identified. Transgastric or transduodenal route was selected based on the proximity of the necrotic collection, ensuring minimal distance between pancreatic necrotic collection (PNC) and lumen and no intervening blood vessels. The collection was punctured with a 19 G EUS-fine needle aspiration needle (Echotip; Cook Endoscopy, Winston-Salem, NC, USA). After ensuring an optimal puncture, stylet was removed and necrotic material was aspirated for culture. Subsequently, a 0.035/0.025-inch guidewire was coiled into the cavity under EUS and fluoroscopic guidance. The tract was then dilated using a 4 mm biliary dilatation balloon catheter or a 6F electrocautery dilator. Subsequently, the drainage was achieved using multiple plastic stents or a biflanged fully covered self-expanding metallic stent (BFMS) as per the endoscopist discretion, percentage of necrotic debris, and patient's preference. Among the recipients of plastic stents, the tract was further dilated up to 12–15 mm using wire-guided hydrostatic dilatation balloon (CRE-balloon dilators; Boston Scientific, Natick, MA, USA) and multiple, 7 Fr or 10 Fr, 5 cm, double-pigtail plastic stents were deployed. A 7 Fr nasocystic drain catheter was additionally deployed in patients who were drained using plastic stents during the initial procedure for the purpose of irrigation and active aspiration. In the other group of patients, a BFMS (NAGI stent [14 mm or 16 mm], Taewoong Medical Co., Ltd., Seoul, Korea or Plumber Stent [16 mm diameter], MI Tech Gyeonggi-Do, 17706, Korea or Hot Axios stent [15 mm diameter], Boston Scientific, Natick, MA, USA) was deployed directly after initial dilatation under EUS and fluoroscopic guidance.

Patients clinical condition was monitored and a repeat contrast-enhanced computed tomography (CT) abdomen was performed after 72 h of the ETD to look for residual collection. If the patient responded to therapy with reduction in collection size by >50%, nasocystic drain was removed. The patients who developed new onset or persistent fever or organ failure, along with persistent residual collection, underwent additional procedures with one or multiple sessions of direct endoscopic necrosectomy (DEN). Among the patients who received plastic stents, the tract was first dilated up to 15 mm after removal of previously placed stents. Subsequently, a standard gastroscope was introduced into the cavity and necrosectomy was performed. Upon completion, multiple plastic stents were replaced. Among the patients in whom a BFMS was placed, the gastroscope was directly introduced into the cavity via the metallic stent and necrosectomy was performed. Additional sessions were performed if needed in a similar fashion after assessing the clinical response at intervals of 72 h. The decision for surgical necrosectomy (open or laparoscopic) was taken for patients who failed to improve after reviewing the clinical condition and radiological findings, in consultation with patient and pancreatic surgeons.

All patients underwent an ERCP upon radiological resolution of collection and clinical improvement to ascertain the status of pancreatic duct. In patients with a normal pancreatic duct (no leak), all stents were removed and patients were rendered stent free. In patients with a partial disruption of pancreatic duct, placement of a bridging transpapillary stent was attempted and all transmural stents were removed if successful. However, long-term indwelling plastic stents (3 cm or 5 cm in length) were allowed to remain indefinitely in patients who had a documented disconnected pancreatic duct syndrome (DPDS) on ERCP.[23] In the patients who had received a BFMS initially and had a DPDS not amenable to transpapillary bridging, the BFMS was removed and replaced with single or multiple permanent indwelling transmural plastic stents. Following removal of BFMS, the collapsed cavity was cannulated using an ERCP cannula followed by placement of double pigtail plastic stent/s.

Image guided percutaneous drainage

Insertion of PCD catheter was carried out by an experienced interventional radiologist under ultrasound or CT guidance. The procedure was conducted under local anesthesia utilizing Seldinger technique. After localizing the collection and identifying the appropriate route and site, initial puncture was made using an 18 G needle. Aspirated liquid necrotic material was sent for culture. A 0.035-inch guidewire was passed through needle and coiled followed by dilatation of the tract using fascial dilators. Finally, a drainage pigtail catheter was passed over the guidewire and secured using sutures. The size of initial catheter (10–14 F) was chosen as per the discretion of the radiologist. PCD was continued in the patients who responded.

Among the patients who failed to respond clinically, imaging (ultrasound or CT) was repeated to look for residual or a new collection. These were subsequently tackled by insertion of additional PCD catheters, upsizing, repositioning, and irrigation (normal saline or streptokinase solution) and aspiration of the catheters as described by us previously.[24] Surgical necrosectomy was eventually done in patients who failed to respond despite adequate PCD in consultation with patient's family and pancreatic surgeons. The PCD catheter was eventually removed in patients who responded clinically, had resolution of collection on imaging and the drain output remained <20 ml/day for three consecutive days.

Definition

Early drainage was defined as drainage performed within 4 weeks of disease onset (onset of pain abdomen). Technical success was defined as success in placement of PCD catheter or EUS-guided stent (plastic or BFMS) in an initial attempt. Clinical success was defined as improvement in the clinical condition (pain, fever, leukocytosis, and organ failure) of the patients accompanied by the radiological resolution of PNC and avoidance of surgery.

Follow-up

Patients in both the groups (PCD and ETD) were followed till the final outcome (improvement/discharge, surgery, or mortality). The groups were compared for the demography, baseline characteristics, indications of interventions, number and types of interventions performed, complications encountered, need for salvage surgery, and final outcome.

Statistical analysis

The qualitative data were presented as percentages and the quantitative data were expressed as mean and standard deviation or median and range as applicable. Student's *t*-test and Mann–Whitney U-test were used to analyze quantitative data. The qualitative data were analyzed using Pearson's Chi-square test and Fisher's exact test. Normality of the data was assessed using Shapiro–Wilk test. A two-tailed $P \leq 0.05$ was considered statistically significant.

RESULTS

Demographic profile

During the study period, 64 ANP patients with WON were identified who underwent early drainage (within 4 weeks of the disease onset) via either PCD or ETD and were included in the final analysis. Among these, 41 (64.06%) patients were managed with PCD (males – 29 [70.73%], mean age: 39.68 ± 10.29 years), while 23 (35.94%) patients were managed with ETD (males – 19 [82.61%], mean age: 36.13 ± 9.14 years). Alcohol (39/64, 60.94%) was the most common etiology of ANP followed by gallstone (15/64, 23.44%), idiopathic (5/64, 7.81%), and post-ERCP (3/64, 4.69%), whereas 1 patient each was caused by abdominal trauma and hyper triglyceridemia. The demographic profile of both the groups was comparable [Table 1].

The mean size of necrotic collection measured prior to drainage was also comparable between the PCD and ETD groups (12.56 ± 2.25 cm *vs.* 12.52 ± 2.31 cm, respectively, $P = 0.947$). The sites of PNC were also comparable between both the groups, with pancreatic body being the most common site (body, head, and tail − 75.61%, 14.63%, and 4.88% and 91.3%, 4.35%, and 4.35% in the PCD and ETD groups, respectively, $P = 0.391$) [Table 1].

Drainage procedure

The mean time of intervention since the onset of disease was comparable between both the groups (24.22 ± 2.04 days in the PCD group and 24.21 ± 2.33 days in the ETD group, $P = 0.848$). Infection remained the most common indication of performing a drainage procedure in both the groups; while it was more common in the PCD group (39/64, 95.12%) as compared to the ETD group (18/23, 78.26%), the difference was not statistically significant ($P = 0.088$) [Table 1].

Among the 41 patients who were managed with PCD alone, 32 (78.05%) patients underwent placement of multiple PCD catheters, whereas the remaining 9 (21.95%) patients required a single PCD catheter only. A majority (91%) of patients who underwent PCD were further treated with irrigation via PCD catheter, either by normal saline or streptokinase solution (16 patients).

Among the 23 patients who underwent ETD, 15 (65.22%) were drained using multiple plastic stents [Figure 1], whereas the remaining 8 (34.78%) patients were drained using BFMS [Figure 2]. Eleven (47.83%) patients underwent DEN (mean number of sessions: 6.18 ± 1.74) following initial ETD procedure. The median solid component in WON, as documented

Table 1. Demographic and clinical profile of the patients along with outcome of the study population

Parameter	PCD (*n*=41), *n* (%)	ETD (*n*=23), *n* (%)	*P*
Mean age (years)±SD	39.68±10.29	36.13±9.14	0.173
Males, *n* (%)	29 (70.31)	19 (82.60)	0.292
Etiology, *n* (%)			
Alcohol	23 (56.09)	16 (69.56)	0.562
Gallstone	11 (26.83)	4 (17.39)	
Mean size of PNC (cm)±SD	12.56±2.25	12.52±2.31	0.947
Location of PNC, *n* (%)			
Body	31 (75.61)	21 (91.30)	0.391
Head	6 (14.63)	1 (4.35)	
Mean timing of intervention (days)±SD	24.22±2.04	24.21±2.33	0.848
Infected PNC, *n* (%)	39 (95.12)	18 (78.26)	0.088
Clinical success, *n* (%)	27 (65.85)	20 (86.95)	0.067
Time to resolution (days)±SD	61.92±22.95	30.94±5.67	<0.001
Salvage surgery	13 (31.70)	1 (4.34)	0.011
Complications, *n* (%)			
Bleeding	3 (7.32)	5 (21.74)	0.124
External pancreatic fistula	9 (21.95)	0	0.021
Mortality, *n* (%)	5 (12.19)	2 (8.69)	1.000

PCD: Percutaneous drainage; ETD: Endoscopic transmural drainage; PNC: Pancreatic necrotic fluid collection; SD: Standard deviation

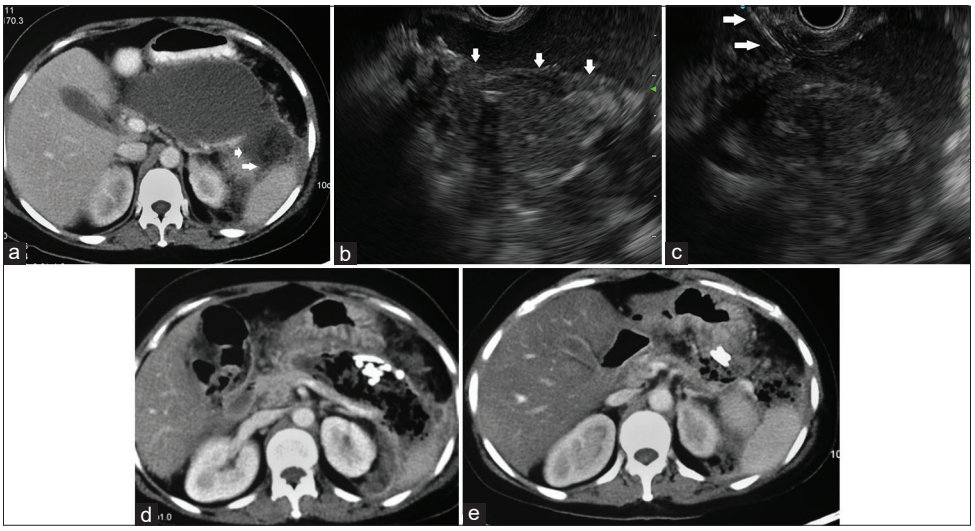

Figure 1. (a) Computed tomography: Large necrotic collection with partially formed encapsulating wall. The area where wall seems to be incomplete has been highlighted with arrows. (b) EUS: Necrotic collection with mixed solid-liquid necrotic content. The solid content has been highlighted with arrows. (c) EUS guided drainage of necrotic collection. Transmural tract being dilated with biliary balloon (arrow). (d) Computed tomography: Residual necrotic collection with multiple plastic stents after three session of ETD and DEN. (e) Computed tomography after five session of DEN. Small residual necrotic collection with complete clinical recovery. Plastic stents are noted. ETD: Endoscopic transluminal drainage; DEN: Direct endoscopic necrosectomy

on EUS, in the ETD group was 50% (range, 30%–60%). BFMS could be replaced with plastic stents in 5/8 (62.5%) patients, whereas in 3 patients, the collapsed cavity could not be cannulated following removal of BFMS.

Outcome

Technical success was achieved in all the patients in both PCD and ETD groups. Clinical success was achieved in 20/23 (86.95%) patients in the ETD group as compared to 27/41 (65.85%) patients in the PCD group, although the difference was not clinically significant ($P = 0.067$). However, compared to the ETD group, the time taken for resolution was significantly longer in patients who underwent PCD (30.94 ± 5.67 days *vs.* 61.92 ± 22.95 days, respectively, $P \leq 0.001$). Despite all the treatment measures, salvage surgery was eventually needed in 13/41 (31.70%) patients in the PCD group, which was significantly higher as compared to the ETD group (1 patient, 4.34%) ($P = 0.011$). The rates of mortality were also comparable between PCD

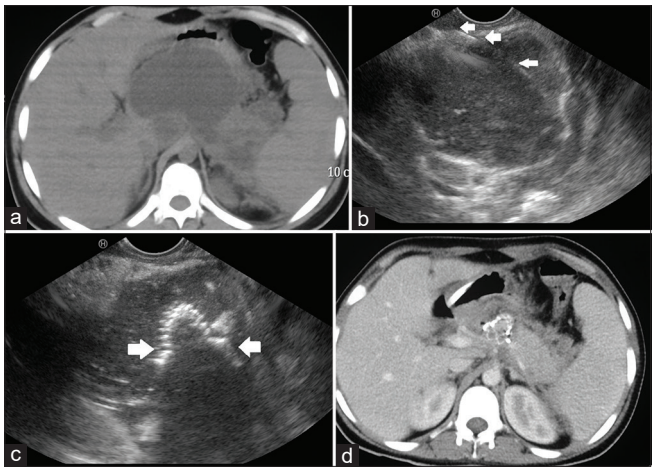

Figure 2. (a) Computed tomography: Large necrotic collection with encapsulating wall. (b) EUS guided drainage of pancreatic necrosis. Guide wire (arrows) seen in the predominantly solid collection. (c) BFMS placed into necrotic collection. On EUS inner opened flange of BFMS noted (arrows). (d) Computed tomography: Resolved WON with BFMS *in situ*. BFMS: Bi-flanged fully covered self-expanding metallic stent; WON: Walled-off necrosis

and ETD groups (12.19% *vs.* 8.69%, respectively, $P = 1.000$) [Table 1].

Among the procedure related complications, the incidence of external pancreatic fistula (EPF) was significantly higher in the patients who underwent PCD drainage as compared to the ETD group (9/41 [21.95%] *vs.* 0, respectively, $P = 0.021$). Although the incidence of bleeding was higher in the ETD group (5/23, 21.74%) as compared to the PCD group (3/41, 7.32%), the difference was not statistically significant ($P = 0.124$). Majority of the bleeding was self-limiting and could be managed conservatively. However, one patient required urgent angioembolization and whereas another patient could not be salvaged despite an emergency laparotomy [Table 1]. The bleeding in patients undergoing DEN was a delayed bleeding and did not occur at the time of index procedure. None of the patients encountered any complications of ERCP including post-ERCP pancreatitis.

DISCUSSION

ANP with infected PNC is associated with a high morbidity and mortality.[25] The management of PNC has remained a significant challenge.[26] While few patients may improve with broad-spectrum intravenous antibiotics along with other supportive treatment alone, many of these patients will eventually require drainage of infected PNC.[27] Albeit associated with high morbidity and mortality, open necrosectomy was the conventional option for managing patients with infected PNC who did not respond to conservative management.[28] Practices have evolved since then with minimally invasive drainage procedures taking precedence over more invasive open surgical procedures.[29,30] It is also recommended to delay drainage procedure till beyond 4 weeks of illness (late phase) so that better demarcation and encapsulation of necrotic tissue may facilitate minimally invasive drainage.[31-33] This cutoff is largely arbitrary and some patients do develop demarcation within 4 weeks.[19,20] Further, many patients with ANP and infected PNC require early intervention due to deterioration of clinical condition.

The role of PCD in managing PNC is well established (both in early as well as delayed phase); however, the use of ETD largely remained limited to delayed phase (>4 weeks).[34-36] Safety and efficacy of ETD during early course of illness is being explored recently. Few studies have attempted to the role of ETD in managing PNC during early phase of illness and found that it is technically feasible with satisfactory efficacy and acceptable complication rates.[19-22] Finally, although studies have demonstrated benefits of ETD over PCD in the form of lower rates of EPF, reintervention rates, rates of surgery, and shorter hospital stay, such a comparison has not been made during early phase of illness.[37,38]

To the best of our knowledge, this is the first study that has compared the efficacy and safety of PCD with ETD during the early phase (<4 weeks) of ANP. Although performed within 4 weeks of disease onset, the procedure in nearly all the patients was still deferred till 3rd–4th week of illness. This delay facilitated better demarcation of PNC on EUS with some semblance of a wall. This was similar to the median time of intervention reported by Chantarojanasiri *et al.* and Oblizajek *et al.* (both reported a median time of 23 days).[20,21] Despite high percentage of solid debris in these collections, nearly two-third of the patients could be managed by multiple double-pigtail transmural plastic stents rather than BFMS. However, merely a single-stage procedure was not sufficient and nearly half of the patients required multiple sessions of DEN prior to improvement. On comparing the overall clinical success and mortality, the rates were comparable between ETD and PCD groups.

The drainage with ETD fared better as compared to PCD in certain domains. Drainage with ETD resulted in significantly shorter resolution time. The need for salvage surgery was also significantly lower in the ETD group. Placement of a PCD allows for drainage of liquid component of the PNC, whereas solid debris may remain behind despite attempts at irrigation and aspiration. This residual debris is difficult to mobilize via small caliber PCD and can act a nidus for getting secondarily infected and propagating the systemic inflammatory response.[19] This may be one of possible causes of failure to respond to therapy, resulting in longer time to resolution and greater need for salvage therapy in the PCD group. In contrast to PCD, ETD permits placement of multiple, large caliber stents along with facility to perform multiple sessions of DEN that facilitates the evacuation of retained necrotic debris.

The incidence of EPF was also significantly lower in patients undergoing ETD as compared to the PCD group. DPDS is a frequent but underrecognized complication in patients with ANP.[39] Patients with ANP with PNC (especially with an underlying DPDS) have a high likelihood of development of EPF if the resultant collection is drained externally via PCD.[40] Internal drainage of PNC via transmural stents during ETD provides internal drainage route into the gastrointestinal lumen, thus reducing the risk of EPF formation.[41]

Although there was a slightly higher risk of bleeding in the ETD group, the difference was not significant. Bleeding remains an important complication of ETD in ANP. The wall of the necrotic cavity may develop extensive collaterals, a process that may be further aggravated by development of left-sided portal hypertension due to splenic vein and portal vein thrombosis. These factors may increase the risk of bleeding, especially during the initial placement of transmural stents (due to rapid decompression) as well as DEN sessions.[42] Therefore, utmost care should be taken while performing necrosectomy. Angioembolization or surgery may be needed urgently if uncontrollable bleed occurs and should be readily available. Apart from the potential benefits mentioned above, ETD can also mitigate many other limitations of PCD including-local site pain, local site infection, inadvertent slippage of catheter, and fistulization into gastrointestinal lumen. Further, multiple PCD are cumbersome to manage and are often associated with stigma.[10,35,43] Percutaneous endoscopic necrosectomy (PEN) is an useful adjunct to PCD and can help in removal of solid necrotic debris from necrotic cavity after placement of PCD and can help in reducing the resolution time as well as avoid surgery.[9] However, to remove solid debris PEN usually requires insertion of wider therapeutic gastroscopes and this, in turn, needs large diameter dilatation of the PCD tract. This large diameter dilatation is painful and usually requires deep sedation/anesthesia. Moreover, there is high risk of EPF formation post PEN.

However, ETD is not meant to be a complete replacement for PCD in this group of patients and PCD will continue to have a niche role. ETD in these patients may be more challenging than draining a well-formed WON or pseudocyst and best be performed by skilled interventional gastroenterologist in carefully selected group of patients. In the absence of necessary expertise, it is best to be avoided and PCD should be preferred. Patient's general condition should also be permissible to allow for multiple sessions of endoscopic procedure under conscious sedations (or general anesthesia). Hemodynamically unstable patients with high oxygen requirement are not the appropriate candidates and should undergo PCD instead. Similarly, the PNC should be located in a favorable location (centrally located), accessible through transgastric or transduodenal route and should be well visualized on EUS examination. PCD should be the preferred option for more peripherally located (paracolic, pelvic, and perirenal) collections. Cost is another important consideration while selecting the modality; although plastic stents may be comparable to cost of PCD, affordability of BFMS may be an issue, particularly in resource constraint settings. The patient must also be willing and motivated to undergo multiple session of procedure if needed. Finally, serious complications may be encountered and prompt back up by interventional radiologist and surgeons should be ensured if ETD is attempted. There are limitations associated with our study. First and foremost, it is a retrospective study and thus suffers from the inherent drawbacks of a retrospective study, including but not limited to selection bias. It is a single-center study and also sample size was limited. Furthermore, data of few patients in the PCD group have been used in previously published papers.[24,43] Patients in both groups underwent variable interventions as well as varying number and types of stents and these could induce potential bias in the results.

Despite the limitations, our study establishes ETD to be safe and efficacious alternative to PCD in management

of PNC during early phase of ANP with possible benefits including reduced resolution time, reduced rates of EPF formation, and lower requirement of salvage surgery. Further larger, multicenter, prospective, randomized studies are needed to confirm our findings and to delineate the role of ETD in early ANP.

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Conflicts of interest
There are no conflicts of interest.

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