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Clinical outcomes of endoscopic ultrasound-guided multiple transluminal gateway drainage for walled-off pancreatic necrosis and pancreatic pseudocysts: a single-center experience

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Abstract

Background Evidence on endoscopic ultrasound (EUS)-guided multiple transluminal gateway technique (MTGT) remains limited. We evaluated the effectiveness and safety of MTGT after ineffective single transluminal gateway technique (SGT) for pancreatic pseudocysts (PP) and walled-off necrosis (WON).

Methods We retrospectively analyzed consecutive patients with symptomatic PP or WON treated at a tertiary endoscopy center between 2018 and 2025. All patients first underwent EUS-guided SGT. MTGT was performed for insufficient collection regression, clinical deterioration suggesting inadequate drainage, or multiloculated collections without inter-compartmental communication.

Results Thirty-two patients (23 men, 71.9%; mean age 58.7 years) underwent MTGT for WON (21/32, 65.6%) or PP (11/32, 34.4%). Infection was present in 21/32 (65.6%); gastric outlet obstruction was the indication in the remainder. Median collection size was 146 mm in WON and 153 mm in PP. Two transmural anastomoses were created in 30/32 and three in 2/32, totaling 66 anastomoses. Active nasocystic drainage was used in 23/32 (71.9%), including all WON cases. Mean endotherapy duration was 61 days, with 3.85 endoscopic procedures per patient. Adverse events occurred in 5/32 (15.6%), mainly bleeding (4/32, 12.5%); surgery was required in 1/32 (3.1%). Mortality was 1/32 (3.1%). Clinical success was achieved in 30/32 (93.8%). During a mean follow-up of 38 months, recurrence occurred in 2/32 (6.3%), both in PP. Long-term success was achieved in 28/32 (87.5%) overall and 28/30 (93.3%) among patients completing therapy.

Conclusion MTGT after ineffective SGT achieved high clinical success, durable outcomes, and acceptable safety in complex PP and WON.

Keywords Walled-off necrosis, pancreatic pseudocyst, endoscopic ultrasound, transmural drainage, pancreatic fluid collection

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Conflict of Interest: None

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Introduction

Pancreatic fluid collections (PFCs) are well-recognized local sequelae of acute pancreatitis and include pancreatic pseudocysts (PP) and walled-off necrosis (WON). Although many PFCs regress with conservative management, a clinically important proportion become symptomatic or infected, presenting with persistent abdominal pain, fever/sepsis, or complications such as gastric outlet or biliary obstruction that mandate intervention. Contemporary management favors minimally invasive, staged strategies with delayed intervention when feasible, typically once collections have matured and become encapsulated, to improve technical feasibility and reduce morbidity [1,2].

Endoscopic ultrasound (EUS)-guided transmural drainage has become a cornerstone of minimally invasive therapy for symptomatic PP, offering effective decompression and source control while avoiding surgery [1-4]. However, WON and PP may be extensive and multiloculated, which can limit the effectiveness of the single transluminal gateway technique (SGT) and contribute to persistent infection, prolonged treatment courses, and escalation to additional interventions such as repeated endoscopy, necrosectomy, percutaneous drainage, or surgery [1-4]. To address inadequate drainage in complex WON, the multiple transluminal gateway technique (MTGT) was introduced, creating two or more spatially separated transmural tracts to enhance drainage and irrigation of necrotic contents and potentially reduce the need for more invasive escalation [5]. MTGT may also be considered in selected complex pseudocysts, particularly multiloculated collections without inter-cavity communication, in which a single access route may not provide sufficient decompression [1].

Although EUS-guided MTGT is recommended in current guidelines, the supporting clinical evidence is largely based on earlier reports involving small patient cohorts and heterogeneous populations, frequently incorporating mixed drainage strategies rather than MTGT exclusively [1-6]. While these studies suggest favorable outcomes, limited sample sizes constrain the precision and generalizability of MTGT-specific estimates. This single-center study addresses this limitation by evaluating an MTGT-only cohort, enabling a methodologically consistent assessment of clinical outcomes in WON and PP. The study provides updated evidence to better define the effectiveness and safety profile of MTGT.

Patients and methods

This study included consecutive patients who underwent endoscopic transmural drainage for symptomatic PP and WON. We enrolled all patients treated at the tertiary Endoscopy Center, Department of General, Gastroenterological and Oncological Surgery, Collegium Medicum, Nicolaus Copernicus University in Toruń, Poland, between 2018 and 2025, in whom initial EUS-guided SGT was performed but proved ineffective. The study was approved by the Ethics Committee at the Collegium Medicum of the Nicolaus Copernicus University (KB 379/2023/5) and was conducted in accordance with the Declaration of Helsinki. All patients provided informed consent for the endoscopic procedures.

A step-up approach to MTGT was used when single transluminal drainage was considered insufficient. Indications included a less than 50% reduction in collection size 7 days after the procedure compared with the pre-drainage measurement; clinical deterioration suggesting inadequate drainage, such as signs of infection or recurrence of symptoms related to pseudocyst compression; and multiloculated collections without communication between compartments in patients who did not improve clinically after EUS-guided SGT.

Procedural techniques

All endoscopic interventions were performed under general anesthesia with endotracheal intubation, with patients in the supine position. All procedures were performed by a single experienced endoscopist.

All patients received preprocedural antibiotic prophylaxis with cefazolin. During each procedure, fluid content from the collection was aspirated and sent for microbiological culture and amylase activity assessment.

Drainage techniques

In WON, ERCP was performed during EUS-guided drainage to evaluate the main pancreatic duct (MPD) for disruption or leakage. When a disruption or leak was detected, transpapillary pancreatic duct stenting was attempted as part of a duct-directed institutional strategy, with the intention of bridging the defect when feasible or supporting ductal decompression. This duct-directed strategy was not considered an integral component of MTGT itself.

Initial transmural drainage was performed using SGT for all collections (PP and WON) under EUS guidance in a standardized fashion using a self-expandable metal stent or plastic stents. For non-cautery-enhanced systems, a 10-Fr cystotome was used for tract creation, followed by placement of a biflanged metal stent (BFMS) measuring 30 or 40 × 16 mm (Hanaro Plumber) and a 7-Fr, 9-12-cm double-pigtail plastic stent (DPS). For cautery-enhanced systems, lumen-apposing metal stents (LAMS; Hot SPAXUS 20 × 16 mm or Hot AXIOS 10 × 20 mm) were used, followed by placement of a 7-Fr, 9-12-cm DPS.

For all WON collections, active drainage was applied using a 6-Fr nasocystic catheter with irrigation using 200 mL of sterile normal saline every 4 hours. Before stent deployment, cyst fluid was collected and sent for cytological, biochemical, and microbiological analyses.

When MTGT was planned after ineffective SGT, the second access site was located within the same collection but distant from the initial tract, using EUS guidance with fluoroscopic assistance to target the farthest inadequately drained compartment. The access technique was repeated at the second site. When WON was collapsed and contained substantial necrotic material, initial puncture with an EUS needle was performed and the collection was filled with saline and contrast to improve EUS and fluoroscopic visibility and to provide sufficient space for stent deployment (Fig. 1, 2).

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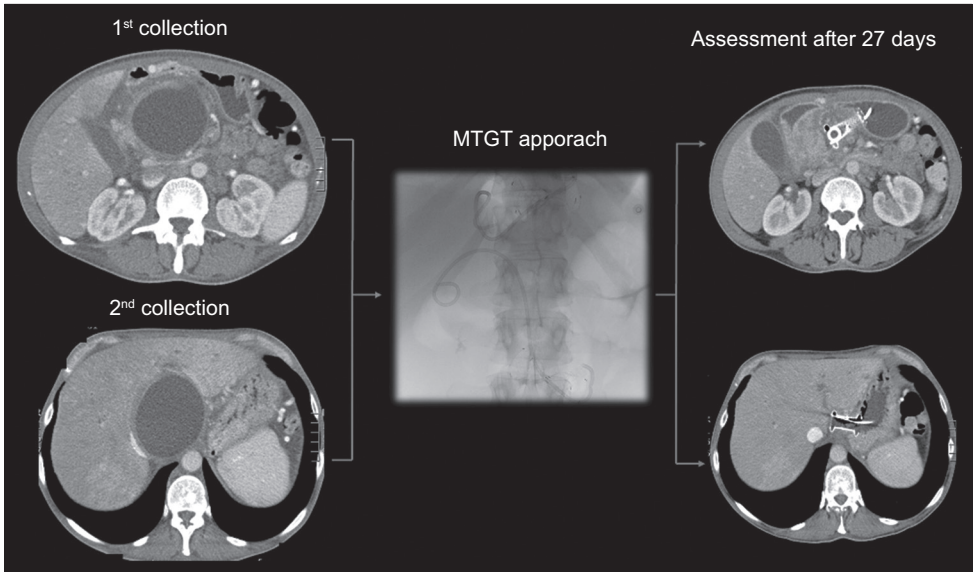

Figure 1 Representative pancreatic pseudocyst case (different patient from Figure 2). Baseline CT demonstrated two pseudocysts measuring 91 × 70 × 70 mm and 78 × 68 × 98 mm. Drainage was indicated because of compression of the portal vein. An EUS-guided cystogastrostomy was performed with creation of two anastomoses, each stented with a LAMS, with a DPS placed through both tracts. Follow-up CT performed 27 days later showed regression of both collections
CT, computed tomography; EUS, endoscopic ultrasound; LAMS, lumen-apposing metal stent; DPS, double-pigtail stent

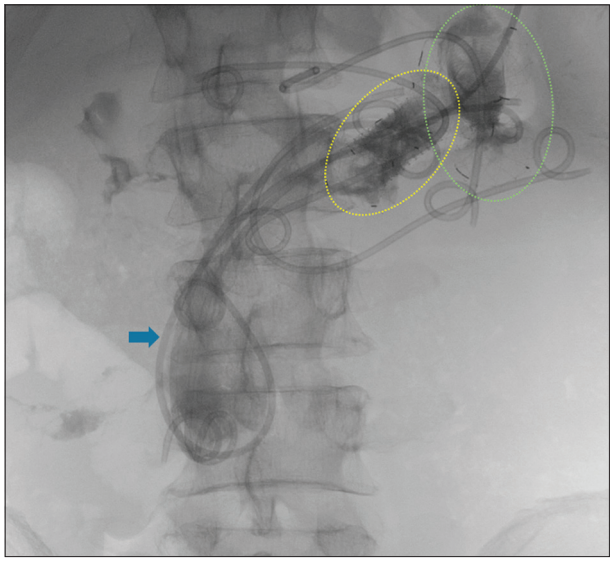

Figure 2 Representative infected walled-off necrosis case (different patient from Fig. 1). The infected WON (approximately 10 cm) was initially treated with SGT. Because the response was inadequate, a second transluminal tract was created to enhance drainage, and active nasocystic drainage was applied (blue arrow). In total, two LAMS (yellow and green circles) and two DPS were placed, resulting in clinical success
WON, walled-off necrosis; SGT, single transluminal gateway technique; LAMS, lumen-apposing metal stent; DPS, double-pigtail stent

Postprocedural care

Nasocystic catheters were irrigated and aspirated with 200 mL of sterile normal saline every 4 hours. Contrast-enhanced computed tomography (CECT) was repeated approximately weekly. The nasocystic drain was removed when imaging demonstrated an approximately 50% reduction in collection size together with clinical improvement and when catheter aspiration yielded no residual necrotic content.

In patients with ongoing symptoms, further management was individualized following multidisciplinary discussion. The timing of repeat endoscopic sessions and subsequent CECT examinations was not fixed and was guided by the patient's clinical course.

LAMS and BFMS were maintained in situ for 4-6 weeks. When clinically indicated, metal stents were exchanged for plastic stents to prevent adverse events or facilitate long-term drainage. Following hospital discharge, the follow-up protocol consisted of CECT at 4-6 weeks, followed by subsequent evaluations at 3, 6, and 12 months and annually thereafter. In the presence of disconnected pancreatic duct syndrome confirmed on ERCP or magnetic resonance cholangiopancreatography, individualized management was applied, including prolonged or long-term indwelling plastic stenting with follow-up-based individualized removal.

Definitions of treatment success and recurrence

Infection of the collection

Infection of PP or WON was diagnosed by positive microbiological culture of aspirated fluid, or by clinical signs and laboratory evidence of systemic inflammatory response, including fever with a white blood cell count >10,000/μL

or <4,000/μL and C-reactive protein >1 mg/dL, and/or the presence of extraluminal gas bubbles within the collection on CT.

Clinical success

Clinical success was defined as resolution of symptoms and either complete regression of the collection or reduction of the collection to <40 mm, assessed during follow-up after completion of active drainage. Recurrence was defined as reappearance of symptoms and/or an increase in collection size to >40 mm during follow-up. Long-term success was defined as clinical success maintained without recurrence during follow-up; when reported among patients completing therapy, the denominator excluded patients who did not complete endotherapy because of death or surgical rescue.

Statistical analysis

All statistical calculations were conducted using TIBCO Statistica software (Data Analysis Software System), version 13. Quantitative variables are characterized using arithmetic means, standard deviation, median, and minimum and maximum values (range). Qualitative variables are presented as numbers and percentages.

Results

A total of 32 patients (23 men; 71.9%) with a mean age of 58.72 years (range 31-77) underwent endoscopic treatment for symptomatic WON (n=21; 65.6%) or PP (n=11; 34.4%). The etiology of acute pancreatitis was alcohol-related in 19 patients (59.4%) and non-alcohol-related in 13 patients (40.6%), including biliary stone disease in 9 (28.1%), iatrogenic causes in 2 (6.3%), hypertriglyceridemia in 1 (3.1%), and idiopathic pancreatitis in 1 (3.1%). Chronic pancreatitis was present in 10 patients (31.3%). The mean interval from acute pancreatitis onset to initiation of endoscopic drainage was 51 days (range 34-181). Baseline characteristics are presented in Table 1.

Indications for endotherapy

Infection of the collection, confirmed by positive culture of aspirated fluid, was present in 21/32 patients (65.6%). In the remaining 11/32 patients (34.4%), symptoms of gastric outlet obstruction constituted the indication for intervention.

Collection features

Among patients with WON, the median collection size was 146 mm (range 88-310), compared with 153 mm (range 114-232) in patients with PP. Overall, 24/32 patients (75.0%) had collections extending both into the pancreas and peripancreatic space (WON: 19/21, 90.5%; PP: 5/11, 45.5%), whereas 8/32 patients (25.0%) had exclusively peripancreatic collections (WON: 2/21, 9.5%; PP: 6/11, 54.5%). Collection features are shown in Table 2.

Table 1 Baseline patient characteristics

Characteristic	Value, n (%) or mean (range)
Male sex	23 (71.9)
Age, years	58.72 (31-77)
Diagnosis	
Walled-off necrosis (WON)	21 (65.6)
Pancreatic pseudocyst (PP)	11 (34.4)
Etiology of acute pancreatitis	
Alcohol-related	19 (59.4)
Non-alcohol-related	13 (40.6)
Biliary stone disease	9 (28.1)
Iatrogenic	2 (6.3)
Hypertriglyceridemia	1 (3.1)
Idiopathic	1 (3.1)
Chronic pancreatitis	10 (31.3)
Time from acute pancreatitis onset to drainage, days	51 (34-181)

WON, walled-off necrosis; PP, pancreatic pseudocyst

Table 2 Pancreatic fluid collection features

Variable	Overall (N=32)	WON (n=21)	PP (n=11)
Collection size, mm, median (range)	-	146 (88-310)	153 (114-232)
Location: pancreatic and peripancreatic	24 (75.0)	19 (90.5)	5 (45.5)
Location: peripancreatic only	8 (25.0)	2 (9.5)	6 (54.5)

WON, walled-off necrosis; PP, pancreatic pseudocyst

Access route and drainage strategy

All patients (32/32; 100%) underwent EUS-guided transmural drainage using MTGT. Three transmural anastomoses were created in 2/32 patients (6.3%), whereas two anastomoses were created in the remaining 30/32 patients (93.8%), resulting in a total of 66 anastomoses: 63 transgastric (95.5%) and 3 transduodenal (4.5%). One patient (3.1%) underwent two transgastric and one transduodenal access, two patients (6.3%) underwent one transgastric and one transduodenal access, and all remaining 29 patients (90.6%) underwent transgastric drainage only.

Among patients with PP, 9/11 (81.8%) underwent passive transmural drainage only, using LAMS plus DPS. The remaining 23/32 patients (71.9%), including 21/21 with WON (100%) and 2/11 with PP (18.2%), underwent active transmural drainage

with placement of a nasocystic drain. In one patient with a multiloculated pseudocyst (1/11; 9.1%), two transmural tracts were created during the index procedure. In the remaining 31/32 patients (96.9%), the mean interval between procedures to create additional tracts was 9 days (range 7-22). Additional percutaneous drainage was used in 3/21 patients with WON (14.3%), corresponding to 3/32 patients overall (9.4%).

Transpapillary MPD stenting was performed as part of the institutional duct-directed strategy in all patients with WON (21/21; 100%), including 15/21 (71.4%) with partial duct disruption and 6/21 (28.6%) with complete duct disruption. In addition, MPD stenting was performed in 2/11 patients with recurrent PP (18.2%). These duct-directed interventions were adjunctive and were not considered a mandatory component of MTGT. Direct endoscopic necrosectomy was required in 14/21 patients with WON (66.7%), with a mean of 2.15 necrosectomy sessions per patient (range 1-6). Procedural characteristics are shown in Table 3.

Table 3 Procedural characteristics

Variable	Value, n (%) or mean (range)
Indication for endotherapy	
Infected collection (positive culture)	21 (65.6)
Gastric outlet obstruction	11 (34.4)
Drainage approach	
EUS-guided MTGT	32 (100)
Number of transmural tracts per patient	
2 tracts	30 (93.8)
3 tracts	2 (6.3)
Anastomoses created (total n=66)	
Transgastric	63 (95.5)*
Transduodenal	3 (4.5)*
Access configuration (patient-level)	
Transgastric only	29 (90.6)
1 transgastric + 1 transduodenal	2 (6.3)
2 transgastric + 1 transduodenal	1 (3.1)
Drainage adjuncts	
Passive drainage in PP (LAMS + DPS)	9/11 (81.8)†
Active transmural drainage with nasocystic drain	23 (71.9)
Additional percutaneous drainage in WON	3/21 (14.3)†
Duct-directed and necrosectomy strategy	
MPD stenting in WON as institutional duct-directed strategy	21/21 (100)†
Partial MPD disruption in WON	15/21 (71.4)†
Complete MPD disruption in WON	6/21 (28.6)†
MPD stenting in recurrent PP	2/11 (18.2)†
Direct endoscopic necrosectomy in WON	14/21 (66.7)†
DEN sessions per WON patient	2.15 (1-6)‡
Timing and treatment burden	
Interval between procedures to create additional tracts, days	9 (7-22)‡
Duration of endotherapy, days	61 (29-173)‡
Duration of active transmural drainage, days	16 (8-31)‡
Endoscopic procedures per patient, n	3.85 (2-11)‡
Length of hospital stay, days	13 (9-26)

*Percentages calculated using 66 anastomoses as the denominator
†Reported as n/N (%) because the denominator is subgroup-specific
‡Data are mean (range)
Procedure time was not systematically captured in the database and was not analyzed
PP, pancreatic pseudocyst; WON, walled-off necrosis; MTGT, multiple transluminal gateway technique; EUS, endoscopic ultrasound; LAMS, lumen-apposing metal stent; DPS, double-pigtail stent; MPD, main pancreatic duct; DEN, direct endoscopic necrosectomy

Duration and intensity of endotherapy

The mean duration of endotherapy was 61 days (range 29-173). The mean duration of active transmural drainage was 16 days (range 8-31). The mean number of endoscopic procedures per patient was 3.85 (range 2-11). Median length of hospital stay was 13 days (range 9-26).

Adverse events

Procedure-related adverse events occurred in 5/32 patients (15.6%). The most frequent adverse event was gastrointestinal bleeding, observed in 4/32 patients (12.5%). Surgical management was required in 1/32 patients (3.1%) because of bleeding, whereas the remaining 3/32 patients (9.4%) were managed endoscopically with blood transfusions and blood derivatives. One patient (1/32; 3.1%) experienced late proximal migration/dislocation of the transmural stent, which was managed endoscopically.

Mortality

Overall mortality was 1/32 patients (3.1%). The cause of death was multiorgan failure in the course of acute pancreatitis.

Clinical success

Clinical success was achieved in 30/32 patients (93.8%). Two patients with WON (2/21, 9.5%; corresponding to 2/32, 6.3% overall) did not complete endotherapy: one developed massive gastrointestinal bleeding due to splenic artery injury during drainage and required urgent laparotomy with splenic artery ligation and surgical drainage of WON, and one died during endoscopic treatment as a result of multiorgan failure in the course of acute pancreatitis.

Recurrence and long-term outcomes

Mean follow-up was 38 months (range 8-64). Recurrence was observed in 2/30 successfully treated patients (6.7%), corresponding to 2/32 patients overall (6.3%). Both recurrences occurred in patients with PP (2/11, 18.2%), whereas no recurrence occurred in the WON subgroup (0/21, 0%). Both recurrence cases were successfully retreated endoscopically.

In both patients, the collection was a PP; both had undergone passive endoscopic drainage, and ERCP demonstrated MPD disruption, for which transpapillary pancreatic duct stenting was performed. Long-term success of endoscopic MTGT was achieved in 28/32 patients (87.5%) overall, or 28/30 (93.3%) among those who completed therapy. Clinical outcomes and adverse events are shown in Table 4.

Discussion

In this single-center cohort of symptomatic PP and WON treated with MTGT after ineffective initial SGT, we observed a high clinical success rate (93.8%), durable long-term outcomes, and an acceptable safety profile given the complexity of the treated collections. Long-term success was achieved in 87.5% of the overall cohort and in 93.3% of patients who completed therapy. Recurrence was infrequent and occurred only in the PP subgroup. These findings support MTGT as an effective escalation step within a minimally invasive step-up approach when a single access route does not provide adequate drainage of large, multiloculated, or debris-filled collections. The step-up approach using MTGT as an endoscopic treatment strategy can therefore be applied not only in the endotherapy of WON, but also in selected complex PP.

A central determinant of outcome in symptomatic or infected pancreatic fluid collections is effective and sustained drainage. In extensive or compartmentalized collections, adequate drainage through a single transluminal gateway may be difficult to achieve, potentially resulting in persistent sepsis, prolonged irrigation requirements, and a greater need for adjunctive interventions. MTGT addresses this limitation by increasing drainage capacity and improving access to separated compartments; however, the optimal upper limit of drainage intensity remains undefined. The incremental benefit of additional transmural anastomoses may diminish as the number of tracts increases, while procedure-related risks may accumulate. Moreover, multiple tracts may facilitate retrograde entry of gastric contents into the collection. These considerations are hypothesis-generating and warrant prospective evaluation, but support an anatomy-driven approach in which additional gateways are created to address clearly separated compartments and alternative modalities are considered when further escalation is unlikely to add benefit.

Table 4 Clinical outcomes and adverse events

Outcome	Value, n (%) or mean (range)
Procedure-related adverse events	
Any adverse event	5 (15.6)
Gastrointestinal bleeding	4 (12.5)
Managed surgically	1 (3.1)
Managed endoscopically + transfusion	3 (9.4)
Late proximal stent migration/dislocation	1 (3.1)
Mortality	1 (3.1)
Clinical success	30 (93.8)
Follow-up, months	38 (8-64)*
Recurrence	
Overall (N=32)	2 (6.3)
Among successfully treated patients (n=30)	2 (6.7)
PP subgroup (n=11)	2 (18.2)
WON subgroup (n=21)	0 (0)
Successful endoscopic retreatment of recurrence	2/2 (100)
Long-term success	
Overall (N=32)	28 (87.5)
Among those completing therapy (n=30)	28 (93.3)

* Data are mean (range)
WON, walled-off necrosis; PP, pancreatic pseudocyst

Our findings are consistent with the original comparative experience by Varadarajulu et al. [5], which established the MTGT concept for symptomatic WON and reported treatment success in 11/12 patients (91.7%), with a lower need for surgery compared with conventional single-tract drainage. Importantly, our cohort extends MTGT-specific evidence by applying prespecified criteria for escalation from SGT to MTGT and by providing long-term follow-up in a high-complexity population that included both WON and complex pseudocysts.

In contrast, Mukai *et al* [6] reported excellent outcomes in a larger cohort; however, their treatment strategy incorporated combined endotherapy approaches rather than evaluating MTGT as an exclusive strategy, limiting attribution of benefit specifically to MTGT. Accordingly, while their results support a multi-access philosophy for complex collections, our data provide more direct outcome estimates for MTGT used after predefined SGT failure.

Although our study was not designed as a stent-comparison analysis, our results can be contextualized using contemporary WON evidence comparing LAMS with plastic stents. In the large international multicenter study by Chen *et al* [7], LAMS were associated with higher clinical success, a lower need for surgery, and lower recurrence than plastic stents, with broadly comparable adverse-event rates. Direct comparison with our cohort is not possible because of differences in design and case mix; nevertheless, MTGT-based multi-gateway drainage, complemented by active irrigation and step-up use of direct endoscopic necrosectomy when indicated, may contribute to effective source control in debris-rich collections.

Bleeding was the predominant adverse event in our series. While hemorrhage is a recognized complication of transmural drainage, this finding underscores that MTGT is typically applied to large inflammatory collections in which vascular proximity and pseudoaneurysm risk may be increased and where the cumulative procedural footprint may be larger. The requirement for surgical management in one patient highlights the importance of careful vascular assessment, vigilant

postprocedural monitoring, and prompt multidisciplinary escalation when bleeding occurs.

All WON patients underwent MPD stenting for duct disruption as part of a duct-directed institutional strategy aimed at mitigating ongoing pancreatic leakage and supporting durable resolution in extensive necrosis. This should be interpreted as an adjunctive institutional approach rather than as an integral or mandatory component of MTGT. The independent contribution of transpapillary stenting to outcomes cannot be determined in this observational cohort.

Strengths of this study include consecutive enrollment, a clearly defined indication for MTGT after ineffective SGT, detailed procedural characterization, and long follow-up enabling assessment of recurrence. Limitations include the single-center observational design, absence of a comparator arm, and limited statistical power for multivariable modeling. Procedure time was not systematically captured in the database and therefore could not be analyzed. In addition, all procedures were performed by a single experienced endoscopist in a tertiary referral center; MTGT likely has a significant learning curve, and the present outcomes may not be directly reproducible in lower-volume settings. Moreover, PP and WON are biologically and clinically distinct entities, and this should be taken into account when interpreting the present results. Notably, recurrence in our cohort was observed exclusively in patients with PP, whereas no recurrence occurred in the WON subgroup. Although this may indicate different patterns of long-term behavior after drainage, the limited sample size and small subgroup numbers preclude robust comparative analysis. Accordingly, we did not perform formal statistical comparisons between PP and WON, as such analyses would be underpowered and potentially misleading. These findings should therefore be considered exploratory and hypothesis-generating, and future larger studies should evaluate both entities separately.

Finally, although cost is an important practical consideration when evaluating MTGT against alternative drainage strategies, a formal cost analysis was not prespecified in this retrospective study and reliable comparative cost data were not available, precluding robust conclusions regarding cost-effectiveness.

The clinical implications are twofold. First, MTGT appears to be a reliable option for complex WON and selected multiloculated pseudocysts when initial SGT is inadequate. Second, future multicenter studies should focus on procedural planning metrics, particularly the relationship between collection characteristics and the drainage intensity required (number of gateways/stents, number of sessions, and duration of therapy), with the goal of defining evidence-based thresholds for tract creation and identifying when alternative modalities should be preferred to optimize both efficacy and safety.

Summary Box

What is already known:

- Single transluminal drainage may be insufficient for large, multiloculated pancreatic fluid collections
- Multiple transluminal gateway drainage has been described as an escalation strategy, but published evidence remains limited and often heterogeneous

What the new findings are:

- In this consecutive single-center MTGT-only cohort, clinical success was achieved in 93.8%, with long-term success in 87.5% overall and 93.3% among patients who completed therapy.
- Recurrence was infrequent and occurred only in the pancreatic pseudocyst subgroup
- The study provides detailed MTGT-specific data on tract number, irrigation, necrosectomy use, and long-term outcomes after predefined failure of single-gateway drainage

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