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EUS-guided drainage of Post-Surgical versus Post-Pancreatitis collections (the RESPELL study): A prospective comparison of clinical presentations and therapeutic outcomes

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A R T I C L E I N F O

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A B S T R A C T

Background: Prospective evidence on Endoscopic Ultrasound-guided drainage (EUS-FCD) for Post-surgical Fluid Collections (PS-FCs) is lacking, and differences from Post-pancreatitis collections (PP-FCs) remain undefined.
Methods: All consecutive patients undergoing EUS-FCD with Lumen Apposing Metal Stents (LAMSs) or Double-Pigtail Plastic Stents (DPPSs) between 2020-2024 were included in a prospective registry (PROTECT, ClinicalTrials.gov NCT04813055), with scheduled follow-up exploring efficacy and safety outcomes.
Results: At baseline, PS-FCs (N=41) versus PP-FCs (N=45) occupied fewer abdominal quadrants ($p=0.04$), showed reduced necrotic content (none/≤30% in 68% vs 42%, $p<0.05$), thus less frequently belonging to the high-risk Quadrant-Necrosis-Infection classifier (24% vs 49%, $p=0.02$). PS-FCs more frequently presented infection as the drainage indication (68% vs 29%, $p=0.0003$) and were drained earlier than PP-FCs (35 [17-69] vs 70 [40-200] days, $p=0.0004$), more frequently adopting DPPSs rather than LAMSs. Step-up (including necrosectomy) was significantly less frequent (20% vs 51%, $p=0.002$). Technical (100%) and Clinical success (95% vs 93%, $p=0.9$) were similar, whilst Adverse Events were lower in the PS-FCs (17% vs 40%, $p=0.02$), and no recurrence was registered (versus 7.5% in the PP group).
Conclusions: PS-FCs occur earlier, are more often infected, but display simpler morphology, are more suitable for DPPS drainage, and carry a lower risk of step-up, adverse events, and recurrence.

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1. Introduction

Post-surgical Fluid Collections (PS-FCs) are common sequelae following gastrointestinal and pancreatobiliary surgeries, with an incidence as high as 40% after pancreatic tail resections [1–3].

While up to 90% of PS-FCs resolve spontaneously or with conservative management [1,2,4], large, infected, or symptomatic collections can require active drainage [3,5,6].

Leveraging experience from Post-pancreatitis Fluid Collections (PP-FCs) [7–9], EUS-guided fluid collection drainage (EUS-FCD) is emerging as a preferred primary approach for managing PS-FCs [10,11]. Whether performed with double-pigtail plastic stents (DPPSs) or lumen-apposing metal stents (LAMSs), EUS-FCD has demonstrated similar outcomes compared to percutaneous drainage (P-FCD), with significantly shorter hospital stay, reduced discomfort and lower risk of cutaneous fistulas [6,7,10–12].

An extensive literature exists on the treatment of PP-FCs, including prospective and randomized studies [7,10,11,13–15]. In contrast, literature on the treatment of post-surgical collections mainly consists of small, heterogeneous, retrospective cohorts [16–20]. Available data preliminary suggest that PS-FCs might develop earlier, with predominantly fluid content and limited necrosis, potentially better suited for DPPSs [17,19]. However, no comparison between PS-FCs and PP-FCs is available.

This study aims at prospectively reporting the outcomes of EUS-FCD of PS-FCs, as well as comparing the clinical and morphological characteristics and treatment outcomes between PS- and PP-FCDs.

2. Methods

This was a single-centre prospective cohort study enrolling all consecutive adult patients referred for EUS-FCD, either PS- or PP-FCs, at a tertiary referral academic centre between December 2020 and February 2024. Patients were enrolled in a Prospective Registry of Therapeutic Endoscopic Ultrasound (PROTECT; Clinicaltrials.gov Id=NCT04813055), and included in this study if having ≥30 days of follow-up. See Supplementary Material for ethics, consent, and detailed inclusion/exclusion criteria.

This cohort partially overlaps with a previous publication investigating predictors of the need for step-up to additional procedures after EUS-FCD [21].

See Supplementary Material for an overview of collected variables.

After the procedure, clinical investigators performed daily clinical evaluations during hospitalization and telephonic follow-up, reviewing the electronic medical records, at least every 60 days after discharge.

2.1. Endoscopic procedures

See Supplementary Material for details.

The choice between plastic and metal stent placement was made by the endoscopist according to the collection's characteristics, including size and extent of necrosis content, related to the foreseeable risk of endoscopic necrosectomy [21].

When DPPSs were placed (see Fig. 1), the procedure involved puncture of the collection with a 19-G needle and cannulation with a 0.035-inch, 480 cm guidewire. The tract was created using a 10-Fr cystotome (Cook Medical, Bloomington, Indiana, USA or Endoflex, Niederrhein, Germany) and subsequently dilated with an 8-mm dilation balloon (Hurricane, Boston Scientific, Marlborough, Massachusetts, USA). Typically, one or two DPPSs were placed, most often 10-Fr Solus™ Double Pigtail Sof-Flex® Stent (Cook Medical, Limerick, Ireland).

When a LAMS was chosen (see Fig. 2), it was placed using a free-hand technique with an electrocautery-enhanced system (Hot AXIOS™ Stent, Boston Scientific, Marlborough, Massachusetts, USA), usually between 10 and 20 mm in diameter, most commonly 15 mm. In most cases, a single 10-Fr DPPS was placed coaxially with the LAMS [22].

2.2. Post-procedural care

In case of no or improved symptoms and reassuring biochemistry, the patient was discharged as early as postoperative day 1 and a subsequent follow-up CT scan was planned within 3 to 4 weeks [23] to evaluate morphological response. In case of LAMS, this was propaedeutic to elective LAMS removal (in case of morphological resolution) or direct endoscopic necrosectomy (DEN). Conversely, active removal of DPPS is not routinely performed in our centre.

In case of new, worsening, or non-improving symptoms after index drainage, the first DEN session or additional step-up was usually performed as early as 72 h post-procedure and repeated on demand according to clinical and radiological follow-up.

2.3. Aims

The primary aims of this study were 1) to prospectively report the clinical and morphological presentation and treatment outcomes of PS-FCs treated by EUS-FCD and 2) to compare PS-FCs to PP-FCs treated during the same time frame in the same institution.

See Supplementary Material for secondary aims.

2.4. Definitions

Based on available literature, [21,24–26] each collection was prospectively classified according to:

- Diameter, both as continuous variable and categorical variable with a cut-off of 10 cm;
- Amount of necrosis: <30%, 30-60%, ≥60%;
- the recently proposed [27] and validated [21,28] Quadrant/Necrosis/Infection (QNI) classification.

CT scans were taken as the gold standard for collection diameter. Conversely, EUS assessment was used as the standard for the necrotic extent, based on previous data exploring formally both inter-observer and inter-modality agreement, and demonstrating excellent inter-EUS reproducibility and superior accuracy of EUS over CT, as detailed elsewhere [21] [21]

A collection was considered to be infected when the patient presented with positive blood culture within two days from the first drainage or Systemic Inflammatory Response Syndrome (SIRS) plus a positive collection culture [29].

Superinfection was defined as the onset of infection after EUS-FCD in a patient with sterile collection at the moment of EUS-FCD.

2.5. Outcomes

Technical success was defined as successful DPPS or LAMS placement.

Drainage success was defined as:

- Clinical Success: symptoms resolution with at least a 50% decrease in size of the collection within 1 month at follow-up imaging [30]
- Morphological success: complete disappearance of the collection or reduction to a size <2 cm within 1 month at follow-up imaging [31].

Adverse Events (AEs) were classified according to the American Society of Gastrointestinal Endoscopy (ASGE) lexicon [32].

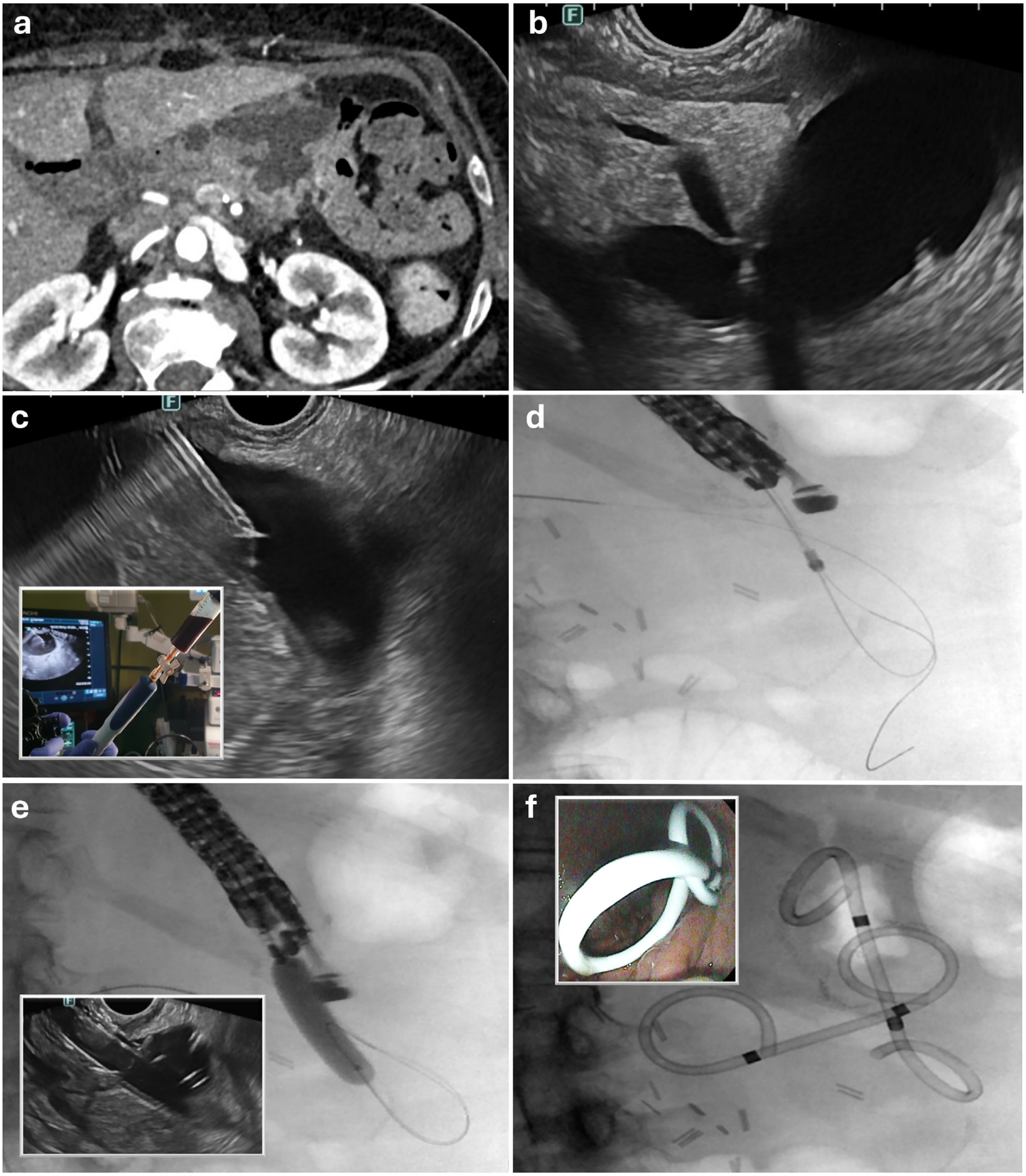

Fig. 1. Post-Surgical Collections: a) CT scan of a collection following pancreatoduodenectomy; b) EUS showed a small fluid collection surrounding the pancreatico-jejunostomy; EUS showed an homogenously fluid appearance, with no necrotic components; c) the collection was punctured with a 19G needle, for microbiological sampling; d) a guidewire was introduced through the needle, thereafter guiding a 10Fr cystotome tract creation; after the cystotome is inside the collection, a second guidewire was advanced; e) tract dilation with a 8 mm balloon; f) placement of two 10Fr double-pigtail plastic stents in the two directions of this bilobar collection.

“Step-up” was defined as any further intervention after the first drainage aimed at improving clinical success or solving an adverse event, including DEN, percutaneous drainage (P-FCD) or surgery [21].

Recurrence was defined as the new appearance of a collection in the same location after former clinical success, requiring a reintervention during follow-up.

Additional registered outcomes were: need for intensive care unit (ICU) stay, enteral or parenteral nutritional, post-procedural hospital stay, survival.

2.6. Statistical analysis

See Supplementary Material for detailed statistical plan.

3. Results

3.1. Baseline characteristics

During the study period, 86 patients underwent EUS-FCD: 45 (52.3%) had PP-FCs, and 41 (47.7%) had PS-FCs. Post-pancreatitis

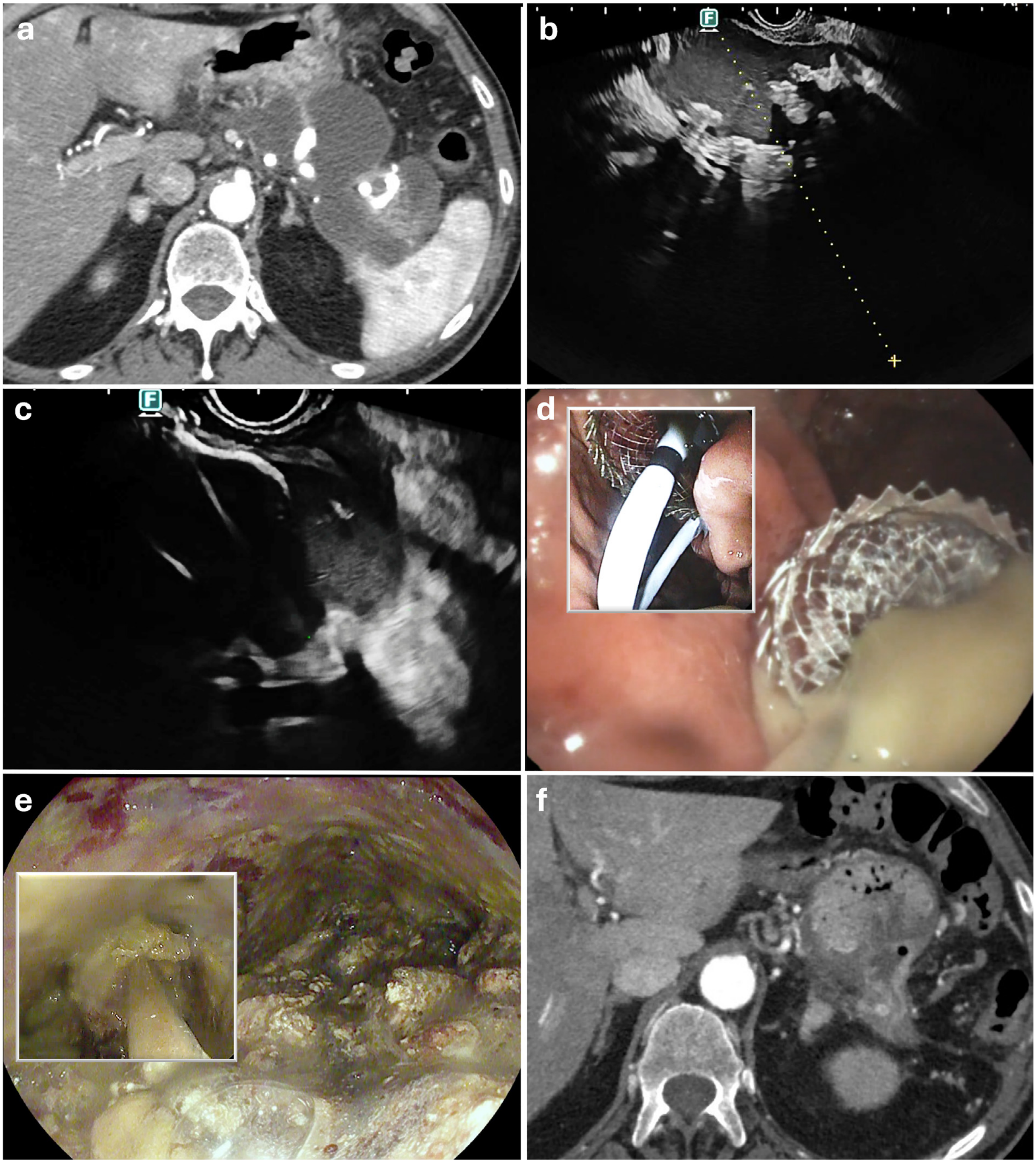

Fig. 2. Post-Pancreatitis Collections: a) CT scan of a Walled Off Necrosis following necrotizing acute pancreatitis; b) EUS showed a large fluid collection, where the fluid part occupied a small volume, whereas the majority of the collection was occupied by hyperechoic necrosis (>60%); c) an electrocautery-enhanced Lumen Apposing Metal Stent (LAMS) was advanced free-hand; d) flow of purulent and necrotic material at release of the gastric flange, followed by placement of a coaxial double pigtail plastic stent to prevent LAMS obstruction; e) direct endoscopic necrosectomy (DEN) was required due to non-improving symptoms; j) final CT scan showing resolution of the collection after DEN and LAMS removal.

collections were classified as WON in 24 cases (53.3%) and pseudocysts in 21 cases (47.7%). The only statistically significant baseline difference between PS and PP patients was a higher median Charlson Comorbidity Index in the PS-FCD group (see Table 1).

3.2. Surgical background

A more detailed description of the surgeries and histopathology is provided in Supplementary Table 1. Most PS-FCs developed after pancreatic resections (n=29, 70.7%), particularly distal pancreatectomies (n=22, 55.3%). Eight (27.6%) were directly related to a clinically relevant postoperative pancreatic fistula (CR-POPF) according to International Study Group of Pancreatic Surgery criteria [33], whereas the remaining were classified as organ-space surgical site infections having occurred after removal of surgical drains. Overall, 25 (61%) surgeries were performed via laparotomy, 15 (36.6%) via laparoscopy. No difference in clinical and morphological presentation was found between collections following pancreatic versus non-pancreatic surgeries (Supplementary Table 2).

Table 1
Baseline Characteristics of patients and fluid collections.

Variable	Post-surgical n= 41	Post-pancreatitis n= 45	p-value
Patients			
Age, years, median [IQR]	65 [55-75]	63 [56-71]	0.5
Male sex, n (%)	22 (53.7)	26 (57.8)	0.7
BMI, median [IQR]	23.4 [21.8-25.5]	25.1 [23.0-27.7]	**0.07**
ASA Score, n (%)			0.3
1	2 (4.9)	3 (6.7)	
2	17 (41.5)	26 (57.8)	
3	21 (51.2)	13 (28.9)	
4	1 (2.4)	2 (4.4)	
5	0 (0)	1 (2.2)	
Charlson Comorbidity Index, median [IQR]	4 [2-5]	2 [1-4]	**0.002**
Indication, n (%)[&]			
Infection	28 (68.3)	13 (28.9)	**0.0003**
Symptoms (abdominal pain; GOO)	15 (36.6)	28 (62.2)	**0.02**
Vascular Compression	0 (0)	9 (20)	**0.003**
Biliary Obstruction	0 (0)	2 (4.4)	0.2
Collections			
Maximum diameter, mm, median [IQR]	80 [65.8-100]	87.5 [71-120]	0.2
Diameter ≥10 cm, n (%)	16 (39)	18 (40.9)	0.9
Number of Abdominal Quadrants involved, median [IQR]	1 [1-2]	2 [1-2]	**0.04**
1 (%)	22 (53.7)	16 (35.6)	
2 (%)	16 (39)	20 (44.4)	
3 (%)	3 (7.3)	5 (11.1)	
4 (%)	0 (0)	4 (8.9)	
Necrosis content (evaluated by EUS), n (%)			**0.048**
Absent or <30%	28 (68.3)	19 (42.2)	
30-60%	8 (19.5)	14 (31.1)	
≥60%	5 (12.2)	12 (26.7)	
High Risk Group, QNI Score[$] (evaluated by EUS), n (%)	10 (24.4)	22 (48.9)	**0.02**
Previous drainage attempts, n (%)	7 (17.1)	4 (8.9)	**0.3**

ASA: American Society of Anesthesiologists; BMI: Body Mass Index; EUS: Endoscopic Ultrasound; GOO: Gastric Outlet Obstruction; IQR: Interquartile Range; QNI: Quadrant-Necrosis-Infection
[$] according to Baroud S et al. *Gastrointestinal Endoscopy* 2023.

3.3. Comparison between post-surgical and post-pancreatitis collections

In PS-FCs, the indication for drainage (see Table 1) was more frequently related to the presence of infection (68.3% versus 28.9%, p=0.0003), whereas in PP-FCs, it was more often due to symptoms associated with local compression, such as gastric outlet obstruction or abdominal pain or vascular involvement.

PS-FCs generally required drainage earlier than PP-FCs (35 [17-69] versus 70 [40-200] days, p=0.004)

3.4. Morphological differences

No significant differences were observed in the median maximum diameter. However, PS-FCs involved significantly fewer abdominal quadrants (see Table 1) and more frequently exhibited lower (<30%) or absent necrotic component on EUS evaluation compared to PP-FCs (68.3% versus 42.2%, p= 0.048). Consequently, patients in the PS group were less frequently classified as High-Risk according to the QNI classification compared to those in the PP group (24.4% versus 48.9%, p= 0.02).

More detailed differences between PS-FCs, Pseudocysts and WONs are detailed in Fig. 3. Post-surgical collections were morphologically more similar to Pseudocysts than WONs, except for the indication for drainage being more frequently infection rather than local complications. Post-surgical collections significantly differed from WONs in terms of number of involved quadrants, necrotic extent and QNI classification.

3.5. Procedural differences

All patients in the PP group underwent transgastric drainage, whilst 85.4%, 3.4% and 12.2% of PS-FCs underwent transgastric, transduodenal or transrectal drainage, respectively. No specific access-related complication was found in the transduodenal/transrectal route.

PS-FCs were more often treated using DPPSs rather than LAMSs (73.2% versus 44.4%, p= 0.007), thus requiring a longer median procedure time (47 [35-57] versus 40 [25-47] minutes, p=0.02).

Outcomes according to DPPS versus LAMS treatment are shown in Supplementary Table 3.

3.6. Treatment outcomes

The flow of individual cases is summarized in Fig. 4 using a Sankey diagram.

Technical (100% vs 100%), clinical (95.1% vs 93.3%, p = 0.9), and morphological success (94.9% vs 88.9%, p=0.3) were comparable between the two groups (Table 2). The five patients who did not achieve clinical success with EUS-FCD underwent a step-up (PS group = 1 P-FCD and 1 Surgery; PP group = 1 P-FCD and 2 Surgeries) but still did not achieve clinical or morphological success.

The need for any step-up therapy was significantly lower in the PS group compared to the PP group (19.5% versus 51.1%, p=0.002, RR=0.38 [0.2-0.76]).

In the PS group step-up interventions were required in eight patients (versus 23 in the PP group): five patients experienced persistent or unimproved infection symptoms, and were therefore managed through DEN (n= 4, one patient also requiring a second EUS-FCD with LAMS after migration of previous DPPS) or P-FCD (n=1); one patient experienced post-procedural bleeding that led to the formation of a haematoma, which was treated with angioembolization and P-FCD; in one case, at follow-up CT scan, a reduction in the size of the collection was observed, but an additional EUS-FCD was performed to evacuate hemorrhagic material within the collection; lastly, a surgical necrosectomy with anas-

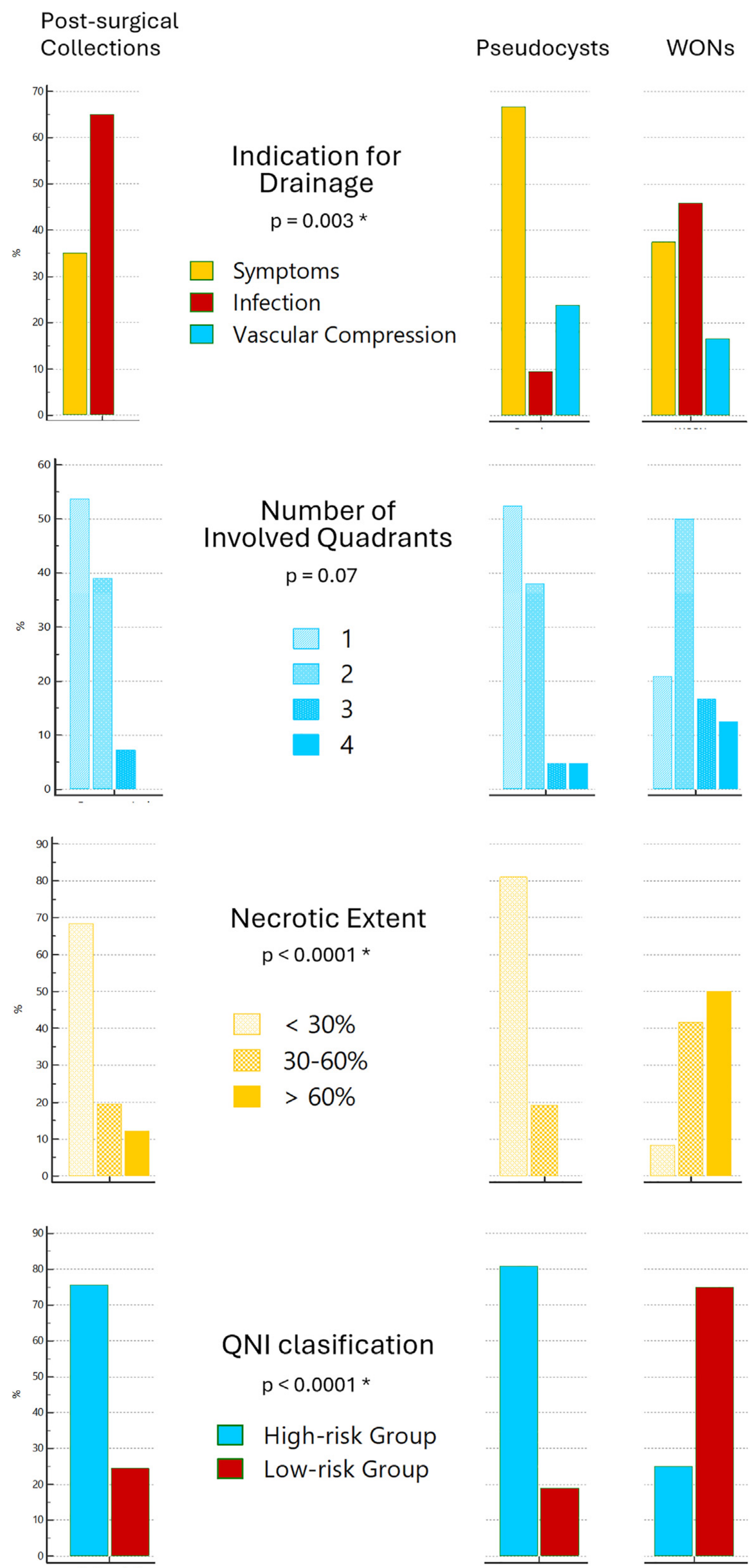

Fig. 3. Morphological differences between Post-surgical Collections, Pseudocysts and Walled-off Necrosis: a) Post-surgical collections (PS-FCs) presented more frequently infection as the presenting symptom, compared to the higher prevalence of local complications in the Post-Pancreatitis group (PP-FCs), especially Pseudocysts which were more frequently sterile. b) PS-FCs were more similar to Pseudocysts in being more frequently confined to one or two single abdominal quadrants, compared to Walled-Off Necrosis (WONs). c) Necrotic extent of PS-FCs was more similar to that of Pseudocysts showing more frequently absent or <30% necrotic extent, compared to WONs harboring more frequently >60% necrotic extent. d) as a result of the Quadrant, Necrosis and Infection (QNI) parameters, the PS-FCs belonged more frequently to the low-risk group of the QNI classification, similarly to Pseudocysts but differently from WONs.

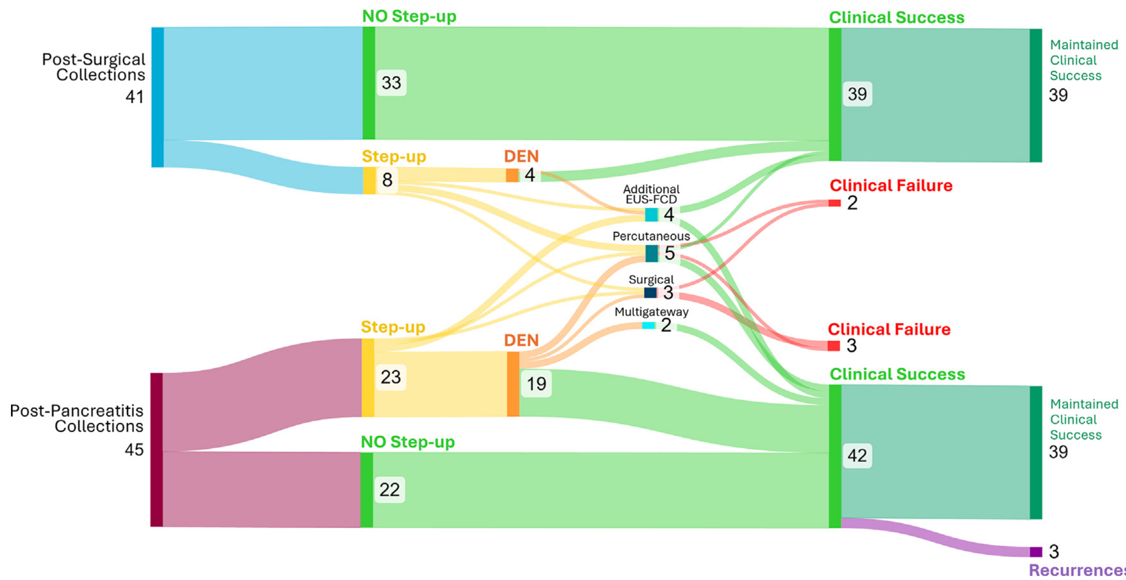

Fig. 4. Clinical Outcomes of Post-Surgical versus Post-Pancreatitis Collections: Sankey Diagram showing the differences between Post-Surgical (PS) versus Post-Pancreatitis (PP) Fluid Collections (FCs) through the flow of single patients (numbers indicate the number of cases; see Table 2 for proportions). Step-up to additional procedures was less frequent in the PS versus PP group (19.5% versus 51.1%, p=0.002). At the end of the step-up approach, treatment outcomes were similar in terms of Clinical Success, but no recurrence were detected in the PS groups.

Table 2
Periprocedural Outcomes.

Variable	Post-surgical n= 41	Post-pancreatitis n= 45	p-value	RR (95% CI) or HR (95% CI)
Drainage Delay, days [IQR]	35 [17-69]	70 [40-200]	**0.0004**	
Treatment, n (%)			**0.007**	**0.48** (0.27-0.45)
DPPS	30 (73.2)	20 (44.4)		
LAMS	11 (26.8)	25 (55.6)		
Drainage route			**0.03**	
Transgastric	35 (85.4)	45 (100)		
Transrectal	5 (12.2)	0 (0)		
Transduodenal	1 (2.4)	0 (0)		
Procedure time, min [IQR]	47 [35-57]	40 [25-47]	**0.02**	
Technical Success, n (%)	41 (100)	45 (100)	1	1 (1-1)
Clinical Success, n (%)	39 (95.1)	42 (93.3)	0.7	1.01 (0.9-1.13)
Morphological Success[&], n (%)	37/39 (94.9)	40 (88.9)	0.3	1.07 (0.94-1.21)
Adverse Events, n (%)	7 (17.1)	18 (40)	**0.02**	**0.43** (0.2-0.92)
ASGE Lexicon			0.1	
Mild	1 (2.4)	6 (13.3)		
Moderate	5 (12.2)	5 (11.1)		
Severe	1 (2.4)	7 (15.5)		
Need for any step-up	8 (19.5)	23 (51.1)	**0.002**	**0.38** (0.2-0.76)
Necrosectomy	4 (9.8)	19 (42.2)	**0.0007**	**0.23** (0.09-0.62)
Non-necrosectomy	4 (9.8)		0.2	0.49 (0.16-1.46)
		9 (22.2)		
Need for nutritional support, n (%)	8 (19.5)	7 (15.5)	0.7	1.25 (0.5-3.15)
Need for ICU stay, n (%)	0 (0)	5 (11.1)	**0.03**	0.10 (0.006–1.75)
Hospital stay, days [IQR]	4 [3-8]	11 [2-23]	**0.03**	
Active stent removal, n (%)	14 (34.1)	25 (55.6)	0.1	
Median Follow-up, days [IQR]	284 [155-603]	429 [122-597]	0.9	
Recurrences[$]	0/37 (0)	3/40 (7.5)	0.09	0.15 (0.008-2.89)
Estimated Overall survival, days, mean [95% CI]	870 [758-982]	1073 [993-1153]	NS	0.46 (0.09-2.3)

ASGE: American Society for Gastrointestinal Endoscopy; CI: Confidence Interval; DPPS: Double Pigtail Plastic Stent; ICU: Intensive Care Unit; IQR: Interquartile Range; LAMS: Lumen-Apposing Metal Stent.
[&] among patients with available imaging
[$] among patients with clinical success and available radiological follow-up

tomotic reconstruction was performed after detecting a colo-colic anastomosis fistula during EUS-FCD drainage. Step-up procedures for the PP group are detailed in Fig. 4.

The AEs rate was significantly lower in the PS group compared to the PP group (17.1% vs 40%, p=0.02, RR=0.43 [0.2-0.92]), with a non-significant trend towards milder severity according to the ASGE Lexicon. All AEs are detailed in Supplementary Table 4.

The most frequent AE in both groups was post-procedural fever due to superinfection of the collection, occurring in 9.8% patients in the PS group and 31.1% patients in the PP group. None of these episodes was severe in the PS group.

The second most frequent AE was bleeding, observed in three cases (7.3 %) in the PS group (two treated by interventional radiology and one requiring a new EUS-FCD to evacuate hemorrhagic material) and 2 cases (4.4%) in the PP group.

No significant difference in the need for nutritional support was detected between the groups (p=0.7). However, five patients in the PP group required ICU stay, compared to none in the PS group (11.1% versus 0%, p=0.03), related to the pre-existent underlying pancreatitis severity and collection-related sepsis. The median hospital stay was significantly longer in the PP group (11 [2-23] vs 4 [3-8] days, p=0.03).

In all patients with PS-FCs drained using LAMS, active stent removal was performed after a median of 40 days. In the PP group, two episodes of spontaneous stent migration were recorded, while in one case the stent was removed during surgical necrosectomy.

During a similar follow-up period (PS: 284 [155-603] days versus PP: 429 [122-597] days, p=0.9), there was a non-significant trend towards lower rate of recurrences in the PS group (0% versus 7.5%, p=0.09, RR=0.15 [0.008-2.89]). These cases were effectively managed endoscopically with new EUS-FCD (n = 2) or surgically (n= 1).

The mean OS was similar between the two groups.

3.7. Subanalyses according to the type of surgery

Clinical presentation and therapeutic outcomes stratified according to the type of surgery are reported in Supplementary Table 5 and compared to those of Pseudocysts and WONs. When considering only FCs following pancreatic surgery (N=26) results were consistent with the general cohort. At baseline, FCs occupied fewer abdominal quadrants and displayed lower necrotic content compared to WONs. Morphologically they had more similarities with Pseudocysts, but clinical presentation was different (infection rather than local complications) and earlier. Similarly to pseudocysts, PS-FCS were more often treated by DPPS, with lower incidence of AEs, need for step-up and recurrence compared to WONs

3.8. Prognostication of the Post-Surgical group, including validation of the QNI classification

PS-FCs patients belonging to the high-risk QNI group had a higher chance of being treated with LAMS versus DPPS (OR=15.8 [2.8-87.3]) and more frequently required step-up to additional procedures (OR=9.3 [1.7-52.1]) see Supplementary Table 6), without any other difference in terms of clinical success, ICU stay, hospital stay or survival.

At multivariate analysis of need of any step-up, a necrotic extent of ≥60% was the only independent predictor (OR=32 [2.8-361.8], see Supplementary Table 7).

4. Discussion

PS-FCs can frequently complicate abdominal surgeries, sometimes causing abdominal pain, fever, or sepsis [34–37]. Given the difficult penetration of antibiotics within encapsulated collections, effective treatment usually relies on active drainage. EUS-FCD has become an established strategy for treating symptomatic or infected PFCs [9–11,38]. Technical and Clinical success of EUS-guided drainage are consistently around 90%, with acceptable safety profile and low recurrence rate [12,35,39,40]. Although percutaneous drainage has been traditionally considered first-line, EUS-FCD offers several advantages, including avoidance of external drains and their discomfort, and reduced risk of chronic fistulas [41]. Recent comparative data shows a trend towards reduced hospital stay and fewer interventions with EUS-FCD compared to P-FCD [6,12,42].

While a large body of evidence exists regarding collections following acute pancreatitis, data on post-surgical collections remain limited and, crucially, only retrospective. Moreover, there has been no attempt to compare the two collection aetiologies, to explore potential implications for clinical practice, including treatment modalities.

In this prospective series of all consecutive non-selective collections treated by EUS-FCD, most post-surgical collections developed following pancreatic resections (70.7%), particularly distal pancreatectomy, consistent with available literature reporting an incidence of 25-45% in this surgical scenario, [34–37] followed by hepatobiliary, colonic and urologic surgeries.

When comparing PS- and PP-FCs at baseline, the postsurgical group showed higher median Charlson Comorbidity Index, likely reflecting the higher prevalence of oncologic patients in this cohort. Moreover, by the prospective assessment of preprocedural imaging and intraprocedural EUS evaluation [21], this study clearly outlined a less complex morphology of post-surgical versus post-pancreatitis collections, as the former mostly involved one abdominal quadrant, and displayed an absent or low (<30%) necrotic component.

Whilst post-pancreatitis collections often arise from peripancreatic necrosis and frequently harbor extensive solid debris, post-surgical ones often arise from localized phenomena, such as pancreatic or biliary leakage, lymphoceles, or organized hematomas, typically occurring in pre-formed surgical spaces and more often unilocular and predominantly fluid. In this scenario PS-FCs are morphologically much more similar to pancreatic pseudocysts rather than WONs, the main difference being in clinical presentation. While pseudocysts commonly present with local complications, such as abdominal pain, gastric outlet obstruction or vascular compression, PS- PS-FCs in this series were more likely to harbour infection as the presenting symptom and required earlier drainage (often earlier than 4 weeks). Indeed, PP-FCs are initially sterile and become secondarily colonized through bacterial translocation in a minority of cases and rarely within the first two weeks [43]. Conversely, many PS-FCs arise in a non-sterile surgical field where the gastrointestinal, biliary, or pancreatic lumen has been opened, this causing primary contamination by endogenous flora, resulting in earlier clinical presentation [44,45]. Anticipating drainage before the standardly adopted 4-week cut-off (30% of the whole cohort, 46% of the PS-FCs group) did not result in increased rate of AEs, paired with recent evidence in necrotizing pancreatitis suggesting that, when collections appear encapsulated, safety of an earlier procedure is not different (despite postponing drainage might potentially result in fewer interventions) [46].

As a result of the less complex morphology, PS-FCs were more frequently classified as “low-risk” according to the QNI classification, thus resulting in a less complex disease course, with reduced need for necrosectomy or additional step-up, and a more frequent resolution after the index drainage. This pairs with recent evidence validating the role of the QNI classifier in predicting more frequent need for additional procedures, higher rate of severe AEs, and longer hospital stay [21,27,28]. Although the QNI classification was originally developed and validated primarily in the context of WONs, previous evidence has suggested its applicability to a broader spectrum of collections [21], and the findings from this series further support its potential relevance for risk stratification and treatment personalization in the setting of postsurgical collections, to be confirmed in larger studies.

Moreover, the more prevalent homogeneously fluid non-necrotic appearance of PS-FCs was also reflected into a higher preference for plastic rather than metal stenting [21]. To date, no study has demonstrated a definite superiority of LAMS versus DPPS, even in more complex collections, such as those with higher necrotic content or larger diameter [47]. On the other hand, LAMS need to be removed at the resolution of the collection, to avoid the risk of AEs such as bleedings [48]. Conversely, DPPSs typically do not require active removal and might be left in situ for longer periods without any apparent AE, potentially reducing the risk of relapse in all those circumstances with potential active leak, such as disconnected pancreatic duct syndrome or pancreatic fistula [49] Interestingly, recurrence was never detected in the PS-FCs group of this series (versus 7.5% in the PP-FCs group) despite the non-significantly different follow-up. A recent monocentric retrospective study reported excellent clinical success of a first-intention LAMS placement across postoperative collections of different origins; however, the median number of procedures per patient was 2[2–3], with 37.9% needing subsequent conversion to double-pigtail stents after LAMS removal, and also detection of a 5% recurrence rate [50]. These findings suggest that a generalized LAMS-first strategy may entail additional procedures and costs; conversely, more favourable, non-necrotic collections (as also selected through the QNI classification) may allow a DPPS-first approach with definitive drainage and without the need for reinterventions in most instances, avoiding unnecessary escalation, reducing the number of procedures, and optimising resources use without compromising outcomes.

This study has several limitations. First, it represents a single-centre experience, with a relatively small sample size, and the population analysed may not fully reflect the broader population of at-risk patients; accordingly, some comparisons can be underpowered (e.g. the risk of recurrence during follow-up), despite the final sample size aligns with what would be required to detect morphological and clinical differences between PS- and PP-FCD based on previous initiatives [21,50]. Second, the group of PS-FCs included different types of surgery (pancreatic, hepatobiliary, colic, urologic), which may raise concerns about internal heterogeneity; however, several sub-analyses demonstrated that collections following pancreatic and non-pancreatic procedures did not differ in terms of clinical presentation, morphological characteristics, and therapeutic outcomes, supporting the validity of analysing PS-FCs as a unified clinical category, sharing postoperative pathophysiological framework. Third, the non-randomized, endoscopist-driven allocation to stent type may introduce bias in the interpretation of treatment–outcome associations and precludes any inference on the intrinsic superiority of one modality over another; however, such selection mirrors the endoscopist’s clinical judgment, with DPPS generally preferred for simple, homogenously fluid collections whilst LAMS for more complex or necrotic ones; in this perspective, the predominant use of DPPS in PS-FCs, together with their more favourable outcomes compared with PP-FCs, indirectly supports the concept that postoperative collections are morphologically simpler and may be primarily managed with plastic stents. Fourth, the PP-FCs group included both WONs and pseudocysts, which differ in terms of morphology and treatment, but we provided subanalyses separating these groups, showing that PS-FCs, despite showing higher rate of infection, are morphologically more similar to Pseudocysts rather than WONs, and were accordingly treated with DPPS rather than LAMS. Finally, our tertiary referral centre has advanced expertise in both LAMS and DPPS placement; thus, outcomes may not be generalizable to institutions with less experience, as DPPS placement is technically perceived as more challenging and has been abandoned by many centres.

Despite these limitations, the study has several strengths compared to the existing literature. First, to the best of our knowledge, this is the first prospective study assessing the technical and clinical outcomes of EUS-FCD for post-surgical collections. Prospective inclusion reduces the risk of selection bias, enhancing the representativeness of the population. Standardized outcome definitions and scheduled follow-up ensured that all relevant post-procedural events were captured, even when managed at external institutions, with no patient lost to follow-up. Second, this is the first comparison of clinical presentation, morphological characteristics and clinical course of post-surgical versus post-pancreatitis collections. Third, this is the first assessment of the prognostic ability of the QNI classification for post-surgical collections, to be validated in broader cohorts.

In conclusion, post-surgical collections differ substantially from post-pancreatitis ones. Despite a more acute and earlier presentation, they exhibit less complex morphology (such as rare necrotic extent), with reduced probability of requiring additional procedures after drainage. These findings support a morphology- and etiology-informed approach to treatment modality, with potential preference for plastic stenting in the post-surgical group, allowing for long-term indwelling, potentially resulting in reduced rate of recurrence. However, this implies the possibility to swiftly switch to LAMS adoption for select complex cases based on intraprocedural morphological assessment. Future, multicentric and larger cohorts are required to confirm these findings, and to explore whether a tailored morphology-based approach can potentially optimize outcomes and minimize risks.

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Ethics statement

Approval of the research protocol by an Institutional Reviewer Board: Yes (178/INT/2020)

Informed Consent: Yes

Registry and the Registration No. of the study/trial: Yes (Clinicaltrials.gov Id=NCT04813055)

Animal Studies: N/A

Declaration of competing interest

GV reports lecture fees and consultancy agreement with Boston Scientific; LA reports lecture fees and consultancy agreement with Boston Scientific and Pentax Medical; MT reports lecture fees from Pentax Medical; MB received grant support from Boston Scientific. RvW holds a consultancy agreement with Boston Scientific and Cook medical, and received speakers fee from Olympus. GC reports consultancy for Boston Scientific, Amgen, Pangenix, Dr Falk and Viatris. SVDM holds the Cook chair in Interventional endoscopy, has consultancy agreements with Cook, Pentax and Olympus and co-chairs the Boston Scientific Chair in Therapeutic Biliopancreatic Endoscopy. All other Authors report no conflict of interest relevant for this article.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dld.2026.01.010.

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