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First-intention EUS-guided transluminal drainage with LAMS: an effective and safe method for management of fluid collections after any kind of surgery

Maria Terrin[1,2] · Francesca D'Errico[1,3] · Hugo Rotkopf[1] · Thierry Tuszynski[1] · Jean-Loup Dumont[1] · Serge Dehry[1] · Roberta Maselli[2] · Alessandro Fugazza[2] · Hadrien Tranchart[4] · Sébastien Gaujoux[5] · Ibrahim Dagher[4] · Olivier Scatton[5] · Alessandro Repici[2] · Gianfranco Donatelli[1,6,7]

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Abstract

Background Symptomatic postoperative collections (PCs) frequently complicate surgery with significant morbidity and mortality. In contrast with pancreatic inflammatory collections, little is known about endoscopic ultrasound-guided drainage of PCs (EUS-PCD). The aim of this study is to evaluate the safety and efficacy of EUS-PCD using lumen-apposing metal stent (LAMS) as the first-line drainage approach for PCs of any kind.

Methods This is a monocentric retrospective study. We retrieved all consecutive symptomatic PCs treated at our center between February 2019 and September 2024. All cases were considered suitable for EUS-PCD after multidisciplinary discussion. Rates of technical success, clinical success, and AEs were calculated.

Results We retrieved 66 PCs, mainly resulting from pancreatic and lower gastrointestinal tract surgery. The median size of collections was 7.6 cm and infection occurred in 54 of the cases. The median time from surgery to drainage was 19 days (IQR 13–29); in 10 cases, this occurred ≤ 7 days after surgery. 51 drainages were performed from the gastric/duodenal window, 15 transrectally. LAMS were removed after a median time of 18.5 days (IQR 12–27). After removal, double-pigtail stents were placed in 25 PCs and at least one necrosectomy session was performed in 13. Technical success was achieved in 97.0% of cases. Clinical success was achieved in 95.2%; in 3 cases, collection recurrence occurred and retreatment with LAMS was successful. Overall AEs rate was 9.1%, but only one was severe, requiring surgery. Rates of technical and clinical failure and AEs were not affected by surgery type (pancreatic, non-pancreatic), timing of drainage (≤ 7, 7–10, > 10 days), size of collections (≤ 4, 4–10, > 10 cm), and access window (transgastric/duodenal/rectal). Necrosectomy performance was the only predictor of AEs occurrence (OR 6.9, C.I.: 1.1–46.9, p = 0.048) at univariable analysis.

Conclusion First-intention EUS-PCD seems to be a safe and effective treatment, regardless of the origin and size of the collection and drainage timing.

Keywords Post-operative collections · EUS drainage · LAMS · Hot Axios · Abscess

✉ Gianfranco Donatelli
donatelligianfranco@gmail.com;
gianfranco.donatelli@unina.it

[1] Interventional Endoscopy Unit, Private Hospital Peupliers, Ramsay Santé, Paris, France

[2] Department of Biomedical Sciences, Pieve Emanuele, Italy and Humanitas Clinical and Research Center IRCCS, Endoscopy Unit, Humanitas University, Rozzano, Italy

[3] Gastroenterology and Endoscopy Unit, Ente Ecclesiastico F. Miulli, Acquaviva Delle Fonti, Bari, Italy

[4] Department of Minimally Invasive Digestive Surgery, Antoine Beclere Hospital, AP-HP, Clamart, France

[5] Department of Hepatobiliary and Pancreatic Surgery and Liver Transplantation, Pitié-Salpêtrière Hospital, AP-HP, Paris, France and Sorbonne University, Paris, France

[6] Department of Clinical Medicine and Surgery, University of Naples "Federico II", Naples, Italy

[7] Unité d'Endoscopie Interventionnelle, Ramsay Santé, Hôpital Privé Des Peupliers, 8 Place de L'Abbé G. Hénocque, 75013 Paris, France

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Post-operative collections (PCs) can complicate gastrointestinal (GI) and hepato-bilio-pancreatic (HBP) surgery in up to 40–50% of patients [1, 2] and, if untreated, symptomatic PCs have a mortality rate between 45 and 100% [3]. Because surgical reintervention is also burdened with high morbidity and mortality, external (percutaneous) drainage first and more recently endoscopic ultrasound (EUS)-guided drainage with the insertion of double pigtails stents (DPS) are the preferred treatment strategies [3, 4]. EUS-guided access has been improved by the introduction of enhanced cautery system and delivery of lumen-apposing metal stent (LAMS) [5] and since 2015, these devices have been integrated into a single system that allows pathway creation and stent release in a single step [6]. EUS-guided drainage with LAMS has now become a standard option for the treatment of inflammatory post-pancreatitis collections given its high clinical success as compared to percutaneous drainage and even surgery [7]–[9]. Moreover, given the promising results, reports of transgastric drainage with LAMS of other PCs (after bariatric, hepatobiliary, colic surgeries) have been reported in the literature in recent years [5, 10, 11] as well as data on the feasibility of drainage from atypical nongastric accesses (transesophageal, transrectal, transjejunal) [12–14]. Figure 1 illustrates the drainage of an infected hematoma of the liver after hepatectomy. However, there are still points to be clarified regarding EUS-guided drainage of PCs (EUS-PCD), particularly how the timing of stent placement affects the safety profile of the procedure, as it is often considered necessary to delay it until the pathologic collection has formed a thick wall (with regard to the risk of leak, perforation, and contamination of the peritoneal cavity) and secondly, on the risk of early and delayed bleeding, related to erosion of vessels due to the prosthesis and thus on the appropriate timing of stent removal [15].

The purpose of this study is to report our experience and to evaluate the safety and efficacy of EUS-PCD as a first-line drainage approach for all types of PCs.

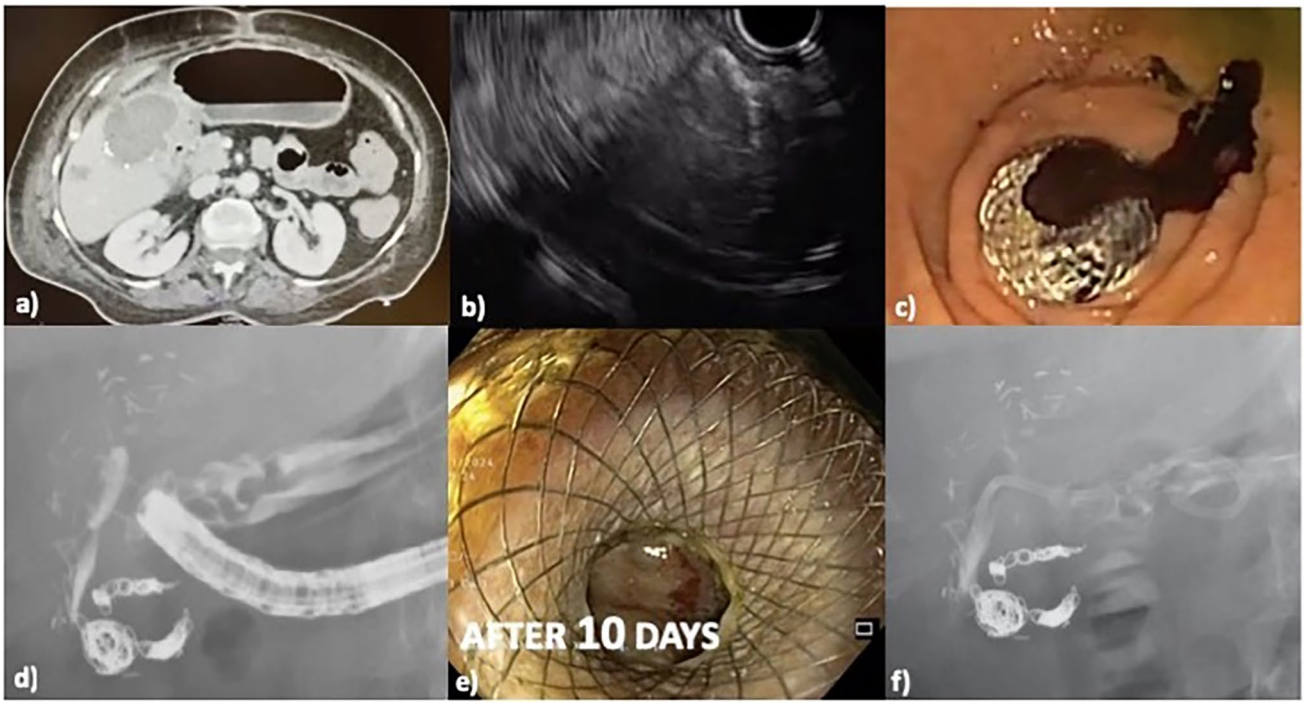

Fig. 1 **a**–**f** Endoscopic ultrasound-guided drainage of a postoperative collection (EUS-PCD), an infected liver hematoma, and its subsequent management: **a** CT image of the collection prior to drainage; **b** EUS view during deployment of the luminal apposing metal stent (LAMS); the distal flange of the stent is visible within the lumen of the collection; **c** endoscopic view of the proximal flange of the LAMS positioned through the gastric wall from which the bleeding material (hematoma) is drained; **d** fluoroscopic view of a gastroscope positioned in the proximal flange of the LAMS; contrast is injected through the lumen of the stent, showing that only a small pseudocavity remains; **e** endoscopic view through the lumen of the LAMS of the bottom of the pseudo-cavity, which appears cleared; and **f** after removal of the LAMS, a double-pigtail stent was placed between the remaining pseudocavity and the gastric lumen to promote granulation (fluoroscopic image)

Materials and methods

Study design

This is a monocentric retrospective study: all consecutive patients treated in our center between February 2019 and September 2024 for a PC were inserted in a prospectively maintained procedure database. Patient demographic, procedural, and outcome data were collected using electronic hospital records. Inclusion criteria were adult patients (> 18 years old); symptomatic PC (e.g., signs of infection, pain, intolerance to oral intake, biliary, or luminal obstruction) not previously treated; evidence of a well-organized collection, clearly demarcated from surrounding tissues even in the absence of a thick wall, as previously confirmed by high-resolution imaging; and multidisciplinary decision to attempt EUS drainage rather than surgical or percutaneous (the proximity of the PCs to the GI tracts reachable with EUS was the main considered factor, in light of the previous reports supporting this technique and its safety). Exclusion criteria were clinical or radiologic signs of perforation or peritonitis or clinical instability (making the patient unable to undergo the procedure); significant alteration in coagulation status that could not be corrected; and previous attempts to PC drainage by other modalities (percutaneous, surgical). Written informed consent was obtained from each patient before the procedure was performed.

EUS-PCD procedure

Drainage times were classified as early (> 7 to ≤ 28 days postoperatively) and late (> 28 days) based on previous literature [15, 16] and at our discretion we also introduced the "acute" category (≤ 7 days). Preoperative coagulation tests (platelet count, PT, and PTT) were obtained for all procedures, and ongoing antiplatelet and anticoagulant medications were reviewed and managed according to guidelines [17, 18]. Patients who were not already on antibiotic therapy received a periprocedural antibiotic injection. All procedures were performed under general anesthesia with endotracheal intubation by 2 endoscopists with more than 15 years of experience (in ERCP, interventional EUS, and radiologic procedures), under endosonographic and endoscopic control, using a therapeutic linear array echoendoscope (UCT180, Olympus ®, Tokyo, Japan) with CO2 insufflation. Additional fluoroscopic control was used according to operator preference. The collection was identified and examined under EUS guidance, to confirm the feasibility and safety of the procedure; Doppler mode was used to ensure that no vascular structures were interposed between the GI wall and the collection. For all procedures, an electrocautery catheter system (AXIOS®; Boston Scientific®, Natick, Mass, USA) was used to access the lumen of the PC and release a LAMS-type stent. The pure cut mode (Auto Cut effect 5, 120 W) of the electrosurgical unit (ERBE USA, Inc., Marietta, Ga, USA) was set, and the stent was placed using the "freehand" and "intrachannel release" techniques. Stent size was chosen individually based on size of collection, anatomical site and access (proximity to vessels), presence of walls, and solid component at EUS evaluation. Drainage fluid was collected for diagnostic analysis (bacteriological, biochemical).

Clinical follow-up, stent removal, and additional procedures

After EUS-PCD, patients were closely monitored, and cross-sectional imaging was performed after 72 h to assess stent position and collection morphology. Stent extraction was scheduled within 2 or 4 weeks (depending on the type of surgery, size and content of the collection, and access window). After LAMS retrieval, DPSs were placed if a pseudo-cavity persisted to facilitate the sealing process; in such a case, a second endoscopy was scheduled after 3 months, and if the stents had not migrated spontaneously yet, they were removed or replaced according to the situation. Any additional endoscopic procedure was scheduled upon request: worsening or persistence of symptoms, imaging showing migration/occlusion of LAMS, persistence of collection or creation of a new collection warranted revision and possibly reintervention such as a necrosectomy session or stent cleaning, and insertion or replacement of one or more additional stents. An imaging evaluation was also scheduled 4 weeks after LAMS extraction or when DPSs were withdrawn. Further imaging studies, during the period of metal stent placement or thereafter, were performed on a case-by-case basis according to the clinical course. Patients were followed clinically for at least 6 months after LAMS placement or unfortunately until death within 6 months. Patients who died from non-drainage-related causes during the observation period were excluded from the analysis of clinical success and late AEs.

Outcome definitions

Technical success was defined as successful placement of LAMS in the PC without intercurrent major periprocedural adverse events (AEs), confirmed by EUS evaluation or fluoroscopy, with outflow of collection content in the GI lumen. Clinical success was defined as resolution of symptoms with normal diet resumption and disappear of collection at cross-sectional imaging after LAMS removal (despite DPS in place), without recurrence requiring another LAMS

placement or drainage by another approach (e.g., percutaneous, surgical) during a follow-up of 180 days. When more than one LAMS was placed in the same patient due to the presence of multiple (nonrecurrent) collections, they were considered separately. Recurrence was defined as a de novo clinical and radiologic presentation of collection at the same site as the index event within 180 days from resolution. AEs related to the EUS-PCD procedure were defined using the ASGE (American Society of Gastrointestinal Endoscopy) lexicon [19] and graded using the AGREE (adverse events in GI endoscopy) classification [20]. An AE was defined as "periprocedural" if it occurred during the endoscopic procedure or within 48 h from the endoscopy. All other AEs were labeled as "delayed."

Statistical analysis

The Shapiro–Wilk test was used to evaluate the continuous distribution of variables. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR). Categorical variables were expressed as numbers and percentages (%). Fisher's exact test was applied to compare categorical data. Factors related to outcomes were analyzed using logistic regression and reported as odd ratios (OR) and 95% confidence intervals (95% C.I.); factors with a p-value < 0.20 on univariate analysis were included in the multivariate model. Statistical significance was considered for two-sided p-values < 0.05. Statistical analysis was performed using STATA® version 18.

Results

Study population

We enrolled 64 consecutive patients with a mean age of 55 years (SD 18.0, range 18–90), 50.0% of whom were male. We recorded overall 66 collections (51 in the upper and 15 in the lower abdomen) that developed mainly after pancreatic (33.3%) and lower GI (31.8%) surgery. Two patients presented with synchronous collections. In 30 patients (46.9%), surgery was performed for oncologic purpose. The mean size of collections was 7.6 cm (SD 2.5) at the time of drainage, 6 collections were ≤ 4 cm and 4 > 10 cm. Most PCs (84.8%) were mixed (solid–liquid) and a hematoma component was present in 12.1%. Infection complicated the PCs in 81.8%. 34 PCs (51.5%) were first diagnosed and treated during the index hospitalization, while the others were recognized after discharge and patients re-hospitalized for treatment. All included patients were followed for at least 6 months. Details about baseline characteristics of patients and collections are shown in Table 1.

Figure 2 shows the flowchart of the study.

Table 1 Baseline characteristics of patients and collections

Total patient population, no. (%)	64 (100)
Male, no. (%)	32 (50.0)
Age (years), mean (SD)	55 (18.0)
Presence of systemic comorbidities, no. (%)	54 (84.4)
Active solid tumor, no. (%)	30 (46.9)
Active smoking, no. (%)	16 (25.0)
Total collections, no. (%)	66 (100)
Surgery type	
Pancreatic, no. (%)	22 (33.3)
Upper GI, no. (%)	12 (18.2)
Lower GI, no. (%)	21 (31.8)
Hepatobiliary, no. (%)	8 (12.1)
Other, no. (%)	3 (4.5)
Size (cm), mean (SD)	7.6 (2.5)
≤ 4 cm, no. (%)	6 (9.2)
> 10 cm, no. (%)	4 (6.2)
Presence of infection, no. (%)	54 (81.8)
Fully liquid collections, no. (%)	10 (15.2)
Hematoma component, no. (%)	8 (12.1)

no. number, *SD* standard deviation

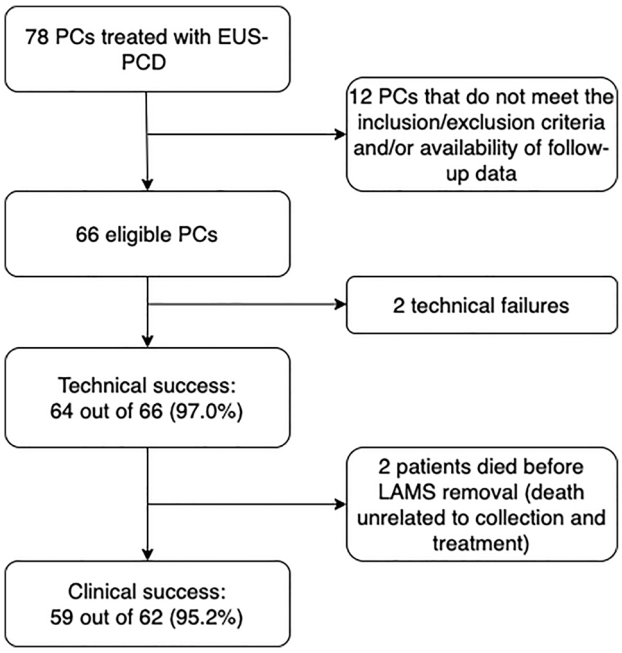

Fig. 2 Flowchart of the study. *PC* postoperative collection, *EUS-PCD* endoscopic ultrasound-guided drainage of PCs

Procedure data

The median time from index surgery to LAMS placement was 19 days (IQR 13–29, range 7–380) and acute drainage (≤ 7 days) was performed in 10 (15.2%) collections. 48 drains (72.7%) were performed from the gastric window, 3 transduodenally and 15 transrectally. Figure 3 illustrates a case of transrectal EUS-PCD for the treatment of a collection after appendectomy.

The most frequently used LAMS size was 10 × 10 mm (50.0%), followed by 8 × 8 mm (21.2%). LAMS were removed after a median time of 18.5 days (IQR 12–27, range 3–65). After LAMS removal, in 25 out of 66 PCs (37.9%), a pseudo-cavity persisted and DPS were inserted (2 to 4 stents, all 7Fr, with a length of 3 to 7 cm). At least one necrosectomy session was performed in 13 (19.7%) (from 1 to 3 sessions). Five patients (underwent distal pancreatectomy) were also treated by insertion of a pancreatic stent by ERCP. The overall median duration of endoscopic treatment per single PC was of 38 days (IQR 21–99, range 3–252). The median number of endoscopic procedures per patient was 2 (IQR 2–3, range 1–9). Further data on the procedures are given in Table 2.

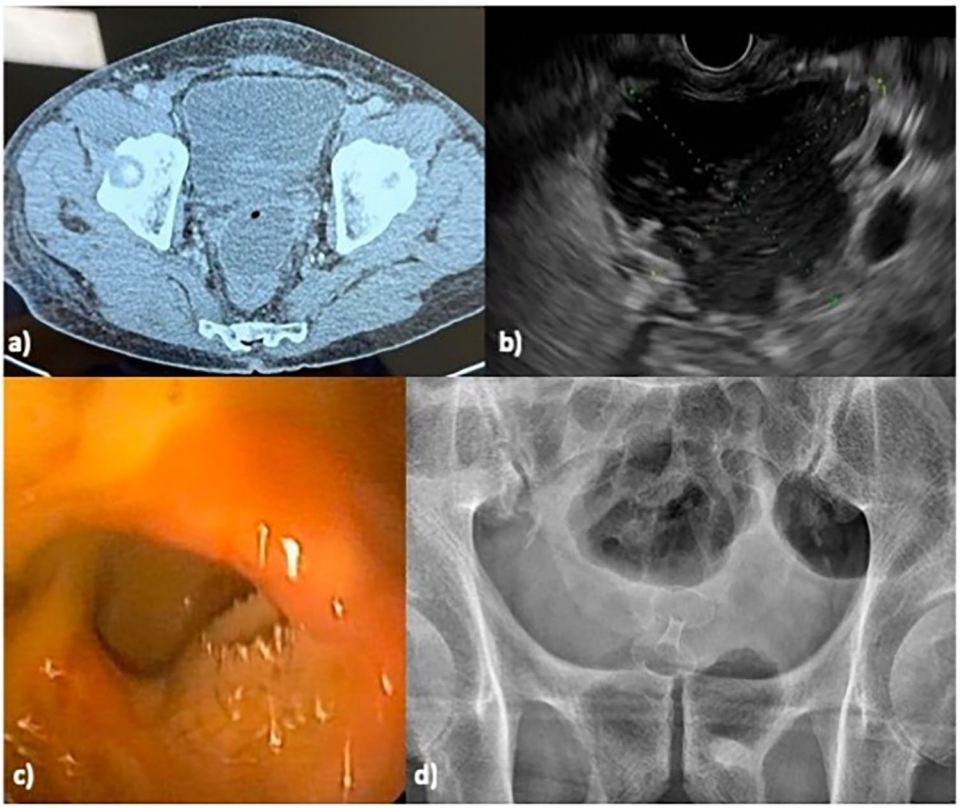

Fig. 3 **a**–**d** Transrectal endoscopic ultrasound-guided drainage of a postoperative collection (EUS-PCD) following appendicectomy: **a** CT image of the collection before drainage; **b** EUS view of the collection before drainage; **c** endoscopic view of the proximal flange of the luminal apposing metal stent (LAMS) positioned through the rectal wall; **d** fluoroscopic view of the LAMS after placement between the lumen of the PC and the lumen of the rectum

Table 2 Details of procedure

Total number of first attempted drainages, no. (%)	66 (100)
Timing of LAMS placement, median (IQR)	19(13–29)
Acute, no. (%)	10 (15.2)
Early, no. (%)	41 (62.1)
Late, no. (%)	15 (22.7)
Window of access	
Transgastric, no. (%)	48 (72.7)
Transduodenal, no. (%)	3 (4.5)
Transrectal, no. (%)	15 (22.7)
LAMS size	
10×10 mm, no. (%)	33 (50.0)
10×15 mm, no. (%)	9 (13.6)
10×20 mm, no. (%)	1 (1.5)
8×8 mm, no. (%)	14 (21.2)
6×8 mm, no. (%)	9 (13.6)
Timing of LAMS removal, median (IQR)	18.5 (12–27)
DPS placement after LAMS removal, no. (%)	25 (37.9)
Necrosectomy performance, no. (%)	13 (19.7)
Endoscopic treatment duration, median (IQR)	38 (21–99)

no. number, *LAMS* lumen-apposing metal stent, *IQR* interquartile range, *GI* gastrointestinal, *DPS* double-pigtail stents

Procedural outcomes

Technical success was achieved in 97.0% (64/66). In two cases, it was not possible to achieve a stable position of the echoendoscope due to factors related to the anatomy or clinical situation of the patient (gastric stricture in sleeve gastrectomy and rectal lumen occupied by stools in a patient unable to prepare) and drainage was not feasible. Both patients were referred for radiologic drainage. Two patients, instead, were excluded from the assessment of clinical success, despite successful drainage and improvement of collection-related symptoms, because they deceased due to underlying pathology (advanced cancer and infected vascular device) before LAMS withdrawal. In drained collections, clinical success was achieved in 95.2% (59 out 62). In 3 collections (4.8%), a recurrence was observed, respectively, after 23, 26, and 171 days by removal of the LAMS, all after distal pancreatectomy. In all 3 cases, PCs were successfully re-treated with EUS-PCD. Out of 66 drainage attempts, a single (1.5%) AE (grade I) occurred periprocedurally, due to stent misdeployment, without the need of defect closure and immediate successful repeated attempt of drainage. In PCs in which technically successful drainage was achieved, delayed AEs were reported in 5 out 62 (8.1%): 2 cases of chronic fistula with upstream colon in patients with Douglas collections after colorectal surgery (one successfully treated with endoscopic closure, grade IIIa, and one requiring surgery, grade IIIb), 2 cases of stent occlusion requiring early endoscopic debridement (grade IIIa), and 1 case of small (< 4 cm) intra-abdominal abscess (treated conservative with antibiotics, grade II).

Factors affecting outcomes

We compared the rates of clinical failure, technical failure, and AEs in the following subgroups: PCs arising secondary to pancreatic surgery *vs*. secondary to surgery of other districts; timing of drainage (acute, early, late); size of collections (≤ 4 cm, 4–10 cm, > 10 cm); access window; and size of stent used. In no case, a statistically significant result was obtained. Regression analysis did not identify factors that predicted technical and clinical success or the occurrence of early AEs. The only factor that significantly predicted delayed AEs was the performance of necrosectomy (OR 6.9 C.I. 1.1–46.9, p = 0.048) at univariate analysis, but was not confirmed at multivariate analysis (p = 0.26). Additional details about regression analysis are reported in Supplementary Table.

Discussion

By analogy with inflammatory pancreatic collections, EUS-PCD for symptomatic collections after pancreatic surgery has been in practice for several years, offering an alternative to percutaneous drainage [21]. Although data are limited, using LAMS as first-line approach instead of DPS is now an established practice, given its greater ease (single step) and rapid and massive drainage of larger and dense PCs, with a similar efficacy and safety profile [7].

EUS-PCD is increasingly popular since it allows drainage of potentially all collections in the vicinity of the GI [10], but studies including PCs derived from different types of surgery are still scarce in the literature and generally report high levels of technical (93–100%) and clinical (90–100%) success, but highly variable rates of AEs (0–25%) and recurrence (0–37%) [3, 5, 15, 16, 22] [23, 24]. With this in mind, our results are very encouraging, given not only the high technical and clinical success rates (97.0%, 95.2%) consistent with previous reports, but especially about the safety profile of procedures (overall AEs rate 9.1%, with no related death, bleeding or perforation) and the low recurrence rate. While most studies have included also some PCs that have already undergone failed drainage attempts (likely inherently complex to treat and burdened by the increased AEs of multiple procedures) [25], our study specifically addresses first-intention drainages. Moreover, it may also be argued that excluding patients with coagulation disorders, we potentially further reduced AE risks, as in the postoperative period this alteration is common. However, although supporting evidence is scarce, EUS drainage is currently

considered high risk for bleeding and in stable patients normalized hemostatic parameters are usually obtained [26], while in critically ill patients case-by-case management is required, balancing risks and benefits. Another important factor of inhomogeneity in previous studies concerns difference in techniques and stent types: even in the most recent studies, single or multistage accesses were used (sometimes even with dilatation of the tract) and both DPS and Axios were used, both "hot" and "cold" [15, 16, 22]. Our large case series stands out by reporting properly the experience of using this technique as first intention, with also high level of standardization of procedures, materials, and subsequent management. This strategy requires rigorous patient selection, and our results must be interpreted accordingly.

On the other hand, the number of pancreatic PCs included in previous studies is also variable, making the picture even more inhomogeneous as these collections have tendentially slightly lower technical and clinical success rates with pooled post-procedural AEs occurrence of 14% and recurrence rate of 9% [8]. Thus, it is not surprising that in a large cohort of EUS-PCDs, the overall AEs rate is 25% (which also includes recurrence cases), where 85% of the included subjects had undergone distal pancreatectomy [15]. From the point of view of different types of intervention, our cohort is more homogeneous, but it should be noted that all clinical failures occurred after distal splenopancreatectomy, and although statistical analysis showed no differences on outcomes in relation to the type of surgery, this finding cannot be ignored from a clinical point of view.

Regarding AEs, while the majority were mild or moderate, we report a single severe AE of a chronic fistula between a perirectal residual pseudo-cavity and the upstream colon after transrectal drainage, which required surgery, and it is not even possible to assess if this was due to the drainage or natural progression of the collection with spontaneous fistulization.

The timespan of drainage is a hotly debated topic. While traditional studies suggest delaying drainage to allow for a mature wall to reduce complications like perforation [27], more recent evidences are debunking this hypothesis for both inflammatory and postoperative pancreatic collections [28]–[30] and also for other PCs, with even better results than delayed drainage [15, 16]. Nevertheless, the very definition of "early" is controversial, with cut-offs ranging from 14 to 30 days [29]. Previous studies already included drainage performed within the first week [31] and in no case, it had an unfavorable relationship with outcomes, which, however, might be masked by aggregation in the "early" group. We arbitrarily introduced the category of "acute" drainage to better stratify the impact of timing, and our results seem to confirm that it is not correlated with worse outcomes, even in the "acute" setting. On the other hand, treating quickly, before the PC becomes pluri-complicated, may have a clinical rationale, possibly reducing morbidity and treatment time. In all 10 acutely treated PCs in our cohort, a superimposed infection and solid material were present. 4 were consequent to lower GI surgery, none were less than 4 cm, and as many as 3 were greater than 10 cm. Only one required necrosectomy.

The other major concern with EUS-PCD is delayed bleeding due to erosion of contralateral vessels as the collection empties [32]. We strongly believe in tailored management of stent removal, which should be adapted to baselines characteristics of the contents of collection and evolution after drainage and should not anyway exceed 4 weeks. In our cohort, the median time of stent embedment was 18.5 days with an IQR of 12–27, reflecting the high number of distal pancreatic collections treated: in this location, in the event that the spleen and its vascular pedicle are preserved by surgery, the LAMS may reach vessels, with risk of erosion [32], and therefore is usually removed earlier, within 2 weeks instead of 4. In one case, however, the stent remained in place for 65 days, fortunately without any AEs occurring; this was a collection after distal pancreatic resection with splenic preservation in a patient who delayed the removal procedure for personal issues.

Regarding the use of coaxial DPS in LAMS, it is not practice of our center to employ them, as we do not believe they improve the safety profile of the procedure as also supported by a recent meta-analysis in the context of pancreatic collections [33]. However, DPS could prevent stent obstruction by solid debris [34] and in our cohort this occurred in two cases, requiring necrosectomy. Coherently, univariate analysis has shown that necrosectomy performance is a predictor of delayed AEs (OR 6.9), such as stent occlusion, while on multivariate analysis, it did not reach statistical significance ($p = 0.26$). This could be related to both the small number of events or it may reflect the complexity of the treated collections themselves, rather than the procedure itself: it is quite intuitive that, if we are dealing with more complex (necrotic) PCs which are naturally prone to develop AEs, more invasive procedures are required.

In 5 patients undergoing distal pancreatic resection, a pancreatic duct stent was also used for evidence of fistula: in two cases, it was placed before PC was evident (and was therefore ineffective in preventing its formation), in two other cases during the same session of LAMS placement (communication with the pancreatic ductal system was evident on control opacification of the cavity), and in the last case at the same time of LAMS removal, because of evidence of communication with the residual pseudo-cavity, where DPS was also placed. As existing data mainly concern duct disconnection syndrome, the literature is unclear about the best management in cases of simple communication between the collection and the pancreatic duct, between use of transpapillary stents and permanent indwelling of

transmural stents [35]. In our experience, a combined treatment of transpapillary drainage and LAMS achieves good results and is mandatory if the PC is due to a pancreatic fistula with liquid content and in close communication with the pancreatic cross-section rather than in cases of distal retrogastric abscess.

We recognize that the study has some important limitations: first, the retrospective and single-center nature that causes inherent biases that limit the generalizability of the results. Our center has distinct and established clinical practices, and we have the availability of both technical and clinical multidisciplinary expertise for the appropriate selection of patients, which may not be available at everywhere. We believe that operators should already have experience in Interventional EUS and drainage of both upper and lower tracts before undertaking these procedures, as experience and higher procedure volume have been shown to be associated with better results in EUS drainage of pancreatic and perirectal collections [36, 37]. However, given the increasing use of therapeutic EUS it is likely that the number of centers with the necessary expertise will soon increase. Second, another major limitation is the lack of a comparison group, particularly with percutaneous drainage. In this field, only the study by Téllez-Ávila et *al.* performed a direct comparison: EUS drainage was found to be equally effective and safe, with a trend toward greater clinical success and lower total costs [3]. Moreover, in two meta-analyses, percutaneous drainage shows similar technical success rates (over 95%) but lower clinical success rates (77–80%) in treatment of pancreatic PCs, being burdened by recurrences in 21–26%, with similar rates of AEs occurrence (about 6–8%) [38, 39]. And further, for gallbladder drainage EUS-guided drainage presents shorter hospital stay, fewer reinterventions, and hospital readmissions [40] as well as does not condition the formation of a chronic external fistula [41]. In our cohort, most patients underwent only 2 procedures, where it is already known that percutaneous drainage usually requires a greater number (2 vs. 4, OR 0.25) [9, 39], thus reducing concerns related to anesthesiologic risk and psychologic impact. Moreover, the additional procedures (necrosectomy, DPS placement) were performed case -by case, never in a protocol manner. In addition, it is our practice to perform necrosectomy through the prosthetic lumen (using a standard gastroscope for stents larger than 10 mm) when it is clinically indicated to keep the LAMS in place and in this regard, we have not recorded any cases of dislodgment or other difficulties unlike what is sometimes reported in the literature [42]. However, LAMS were removed according to the collection site and clinical evolution, without delay due to the need to perform necrosectomy, and when removal was indicated, DPSs were placed to maintain passage and allow obliteration of the residual pseudo-cavity by secondary route. DPSs act as a foreign body by promoting granulation tissue formation [43] and in our experience this strategy is confirmed to be effective, in the absence of persistence of chronic iatrogenic fistula as previously reported [5].

Given all the aforementioned limitations, we acknowledge the need to conduct a multicenter, randomized trial with direct comparison with percutaneous drainage, which will strengthen these results, which reflect clinical practice. In the meantime, it is important that these procedures be performed in experienced centers, as to avoid incurring serious AEs, it is of paramount importance to have the expertise to assess the retrieval (which must be delineated anyway) and thus tailor the timing of stent removal, within a maximum of 4 weeks, and the possible need for further treatment.

In conclusion, the overall picture seems encouraging from the point of view of the efficacy and safety for treatment of symptomatic upper and lower post-surgical collection (following any type of surgery), by EUS PDC with LAMS as first-intention drainage method, even early after surgery. It is equally encouraging when considering that the few patients in whom clinical failure was reported were successfully re-treated with the same method.

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