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Original Research

Effectiveness of endoscopic ultrasound-guided simple puncture-aspiration (non-stenting) in the management of abdominal collections

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Abstract

Background: Endoscopic management of abdominal collections includes endoscopic ultrasound (EUS)-guided transmural drainage, transpapillar via endoscopic retrograde cholangiopancreatography (ERCP), and EUS-guided simple puncture-aspiration (SPA). The latter is little reported, and there are some doubts about its real usefulness.

Objectives: The aim of this study was to assess the effectiveness of EUS-guided SPA as a first-line approach for treatment in selected abdominal collections.

Design: Retrospective observational study performed in two tertiary centers (Barcelona area).

Methods: Inclusion of all consecutive patients with abdominal collections that underwent EUS-guided SPA from July 2007 to July 2021. The decision was based on endoscopist criteria and collection characteristics. Clinical success was defined as avoidance of an additional interventional approach (endoscopic stenting, percutaneous drainage, surgery).

Results: Of 241 patients with abdominal collections treated endoscopically, 55 were included for analysis (mean age, 56 ± 12 years). Collection features: mean size 63.3 ± 24.8 mm; positive culture in 22 (40%) and pancreatic nature in 45 (81.8%). EUS–SPA was performed successfully in all cases, and clinical success was achieved in 76.3% (95% confidence interval (CI), 65.5–87.3) of cases (*n*-42/55). The most frequently used needle size was 19 Ga (85%). A nonsignificant trend for success was detected for noninfected collections (84.8 vs 63.6; $p = 0.07$) and lower size (mean ± SD; 60.2 ± 22.9 vs 73.8 ± 29 mm; $p = 0.09$). Two related adverse events were detected: one bleeding and one abdominal pain. Recurrence was detected in five pseudocysts after clinical success. Median follow-up was 629 days (IQR 389–877).

Conclusion: EUS–SPA of selected abdominal collections seems to be a safe and effective technique, avoiding a more aggressive strategy such as transmural stenting. EUS–SPA may be a viable alternative in collections with limited size and preferably noninfected.

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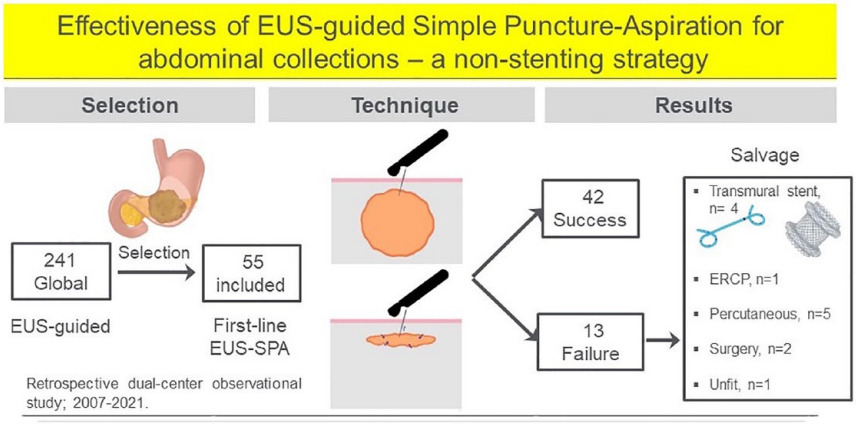
Graphical abstract



Keywords: endoscopic ultrasound, pancreas, pancreatic fluid collections, puncture-aspiration, therapeutic endoscopy

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Introduction

Abdominal collections are associated with a wide range of symptoms, including abdominal pain, jaundice, gastric outlet obstruction, or even sepsis, in case of infection. There are several potential factors that can cause an abdominal collection, such as acute or chronic pancreatic disease or surgery.

Currently, the treatments of choice for abdominal collections are minimally invasive techniques. These mainly include percutaneous drainage and endoscopic management. This latter approach basically refers to endoscopic ultrasound (EUS)-guided transmural drainage and transpapillary drainage via endoscopic retrograde cholangiopancreatography (ERCP). Several studies have shown the high clinical success of these endoscopic techniques for pancreatic or post-surgical collections. However, none of these interventional approaches is exempt from morbidity or serious adverse events (AEs) such as perforation, bleeding, and entero-cutaneous fistula.[1–5]

Another possible approach is EUS-guided simple puncture-aspiration (SPA). This involves complete aspiration of the liquid content until collection collapses without insertion of any transmural stent.

There are few reports on this option, and doubts exist about its real effectiveness and possible association with risk of recurrence.[6,7] A retrospective study compared this technique to transmural drainage by placing a plastic stent in sterile pancreatic abdominal collections. The recurrence of pancreatic pseudocyst was similar for both groups. Moreover, none of the patients undergoing EUS-guided SPA developed infections, perforation, or hemorrhage. The authors concluded that this simple and safe approach could be an option for small pancreatic collections.[7]

Despite these reports, evidence is still scarce. The usefulness and potential clinical benefit of offering EUS-guided SPA as a non-stenting strategy, with the purpose of avoiding more aggressive interventional approaches (endoscopic stenting, percutaneous drainage, and surgery), or reduce the number of related stent issues (e.g., dedicated devices, imaging procedures, or administrative surveillance for stent-removal stent-removal) is not known. Together are an incentive to assess this endoscopic strategy. The aim of this study

was to assess the effectiveness of EUS-guided SPA as first-line treatment of selected abdominal collections.

Methods

Study design

This was a retrospective analysis of the endoscopy units of two referral centers (Barcelona area). The study was approved by our institutional review board (*Comitè d'ètica de la investigació amb medicaments, Hospital Universitari de Bellvitge*; ref. approval No. PR240/2021, June 23, 2021), and was designed in accordance with the ethical guidelines of the World Medical Association Declaration of Helsinki. The reporting of this study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology statement.

Participants

Patients with enlargements and/or clinical symptoms related to abdominal collections were referred for an endoscopic approach. All cases were previously evaluated by means of abdominal computed tomography (CT), magnetic resonance imaging (MRI), or EUS.

Collected data on all consecutive patients who underwent EUS-guided drainage of abdominal collections in a specific prospective database were reviewed, and those treated by EUS-guided SPA were included.

Patients with lack of follow-up information, and those managed by transmural stenting drainage, transpapillary route (via ERCP), or percutaneous drainage, were excluded.

The following variables were reviewed: demographic details, clinical data, collection features (size, pancreatic or non-pancreatic nature, and positive microbiology), procedure and technical details, follow-up data, re-interventions, recurrences, incidents, and AEs.

All imaging parameters were reviewed and taken from the original written reports.

Technique

All patients provided written informed consent before the procedure. All procedures were performed by one of two interventional endoscopists with experience in both EUS and ERCP.

Deep sedation was provided by a non-anesthesiologist or an anesthesiologist, depending on each center's protocol. For patients with antiplatelet or anticoagulant therapy, the recommendations of the international guidelines were followed.[8]

First, a collection was explored and assessed using a linear echoendoscope ((EG-580UT, Fujifilm, Japan; or GF-UCT-180 Olympus, Germany). Second, the EUS-guided SPA as a first-line approach was considered only in selected collections of symptomatic cases or those with enlargement of collection size. The final decision to offer this non-stenting strategy over the others (e.g., transmural stent) was based on the endoscopist's criteria and basically depended on collection size where transmural stenting was considered more technically demanding, and/or an echo pattern excluding solid contents predominance and purulent content, where the benefit of EUS-guided SPA may be doubtful.

Puncture was performed under EUS guidance using a cytological needle (19-gauge or 22-gauge; Echo-Tip, Cook Medical or Expect Slimline, Boston Scientific). Once the needle was inside the cavity, complete aspiration using a syringe was made until collapse of the collection (Figure 1 and Supplemental Figures S1 and S2). This collapse was basically assessed by EUS real-time image under the endoscopist's direct supervision. After removing the FNA needle, the lesion was checked again to ensure the complete collapse. Aspirated liquid was sent for microbiological and/or biochemical analysis if required.

Needle type and size were selected at the discretion of the endosonographer.

No fluoroscopy guidance was needed. Antibiotic prophylaxis was given for all cases. After the procedure, patients were transferred to a medical ward for 4–24 h' observation, according to the medical team criteria.

Follow-up

For all patients, follow-up by outpatient consultation and further abdominal imaging within the first-year post-index procedure was mandatory.

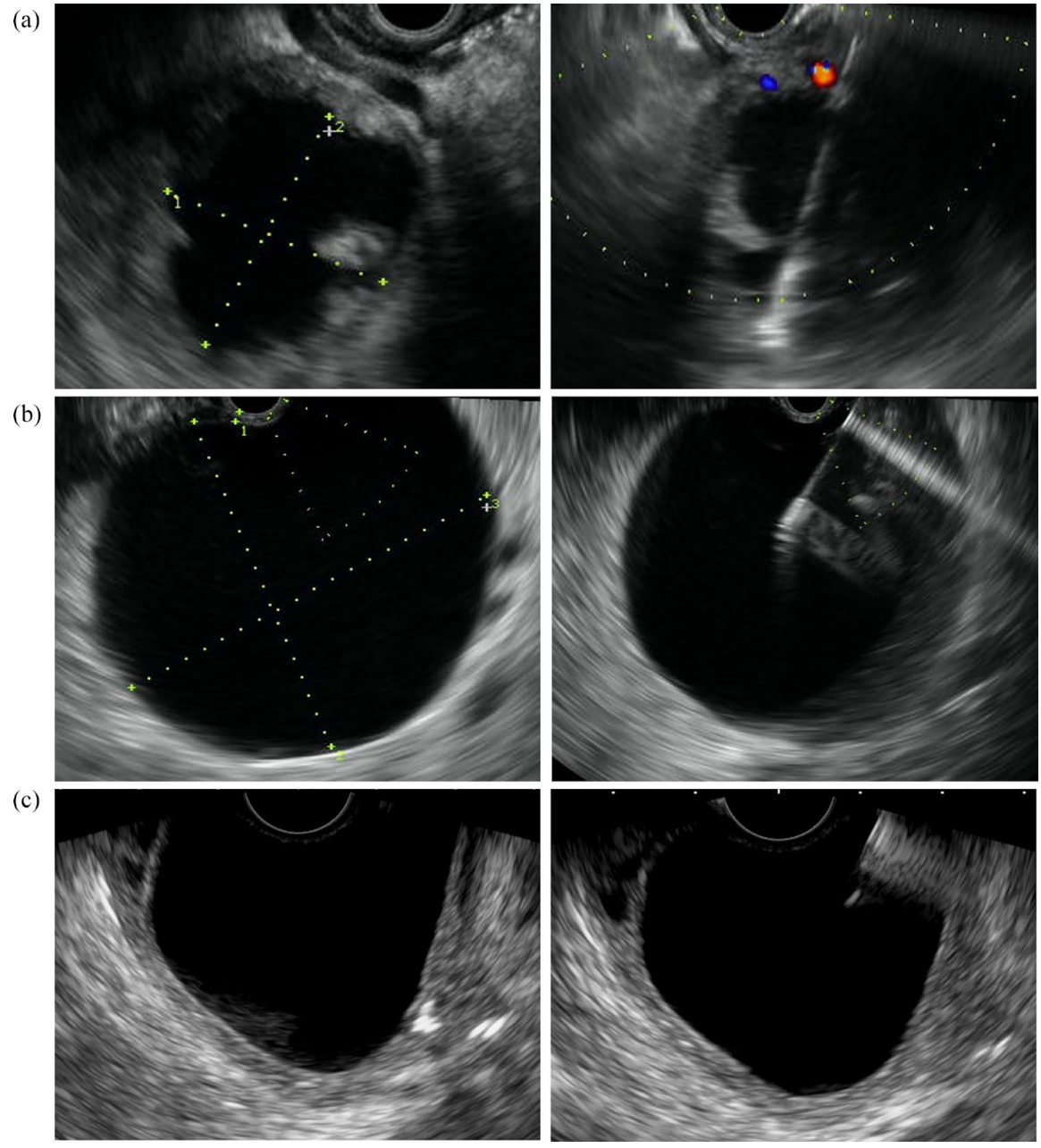

Figure 1. Examples of EUS-guided SPA of three pancreatic collections using a 19G needle: (a) EUS-guided transduodenal puncture of pancreatic pseudocyst causing abdominal discomfort and bile duct compression, with uncomfortable characteristics for transmural stenting (33 per 38 mm in size, pancreatic head, distance >10 mm; gastroduodenal artery as interposal vessel), (b) EUS-guided transgastric puncture of a pancreatic pseudocyst located at pancreatic body, completely anechoic, 67 × 75-mm in size, noninfected suspicious with enlargement and abdominal discomfort and (c) pancreatic pseudocyst located, 40-mm in size with enlargement and abdominal discomfort (case of Supplemental Figure S1).
EUS, Endoscopic ultrasound; SPA, simple puncture-aspiration.

In cases of persistence of collection with clinical symptoms, patients were individually considered for a second EUS-guided SPA attempt, or step-up strategy to transmural drainage with stent insertion, including double-pigtail plastic stent (DPS) or lumen-apposing metal stent (LAMS), percutaneous approach, or surgery. The decision was based on a multidisciplinary committee and

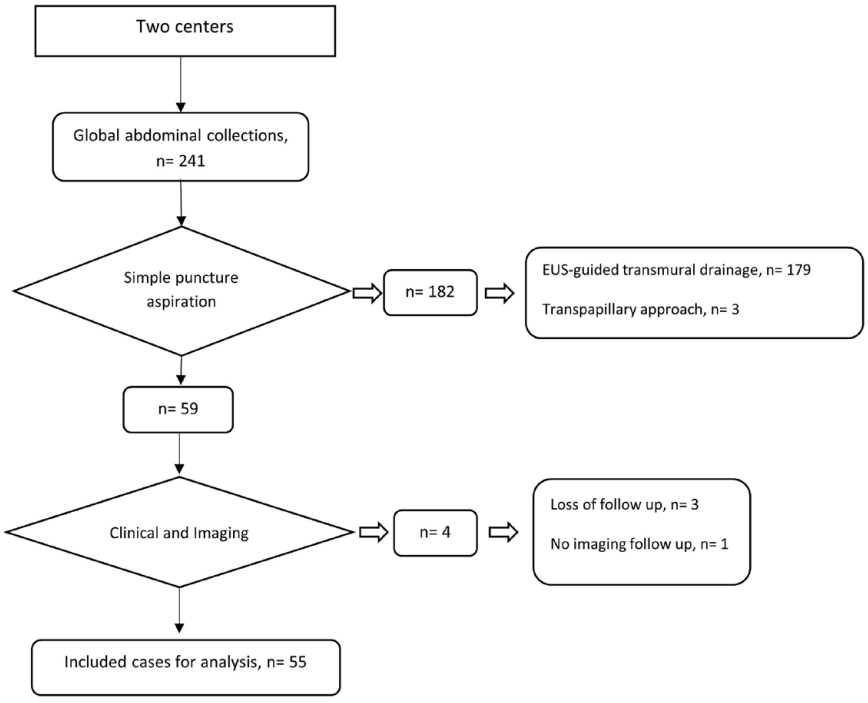

Figure 2. Study flow chart.

intraprocedural endoscopist criteria, according to collection features and clinical background.

Study definitions

- Technical success was defined as needle access inside the collection and complete aspiration till collapse of collection was achieved by EUS guidance.
- Clinical success was defined as avoidance of step-up strategy (interventional approaches such as stenting, percutaneous catheter, or surgery), with clinical improvement in case of related symptomatology 6 months after index procedure.
- AEs were defined and classified according to the recent AGREE classification (adaptation of the Clavien-Dindo for surgical AEs) by the American Society for Gastrointestinal Endoscopy.[9]
- Recurrence was defined as collection reappearance with indication of drainage, after 6 months from the initial procedure.

Study endpoints

The primary endpoint was to assess the effectiveness of the EUS-guided SPA, in terms of clinical success.

Secondary endpoints were to assess the technical aspects, safety, recurrence, and potential factors related to clinical success.

Statistical analysis

Categorical variables were the number of cases and percentages. Continuous variables were the number of cases, mean, and standard deviation (SD), or the median and the interquartile range (IQR). Categorical variables were compared using the chi-squared test and Fisher's exact test. Quantitative variables were compared using the student's *t* test. Univariate analysis was performed to identify variables associated with clinical success. A p-value <0.05 was considered statistically significant. All statistical analyses were performed using SPSS version 23 (IBM, Chicago, IL, USA).

Results

Demographic data

Between July 2007 and July 2021, of a total of 241 patients with abdominal collections, 59 (24.4%) were treated with EUS–SPA. After exclusion of four cases due to loss of follow-up, 55 (22.8%) cases were analyzed (34 men, mean age 56 years ± 12) (Figure 2 and Table 1). The

Table 1. Demographic data and clinical outcomes ($n=55$).

Variables	*n*-55
Median age (SD), years	56 (±12)
Sex (M), *n* (%)	34 (61)
Collection etiology, *n* (%)	
Pancreatic/(pseudocyst, WON, acute collection) Non-pancreatic/(post-surgery,[a] others[b])	45 (81.8)/32 (58.1), 12 (21.8), 1(1.8) 10 (18.1)/9 (16.3), 1 (1.8)
Collection size, mean (SD), mm	63.3 (±24.8)
Positive microbiology, *n* (%)	22 (40)
Follow-up, median (IQR), days	629 (389–877)
Technical success, *n* (%)	55 (100)
Clinical success, *n* (%)	42 (76.4)
Related adverse events, *n* (%)	2 (3.6)
Grade II[c]	1
Grade IIIa[c]	1
Needle, *n* (%)	
19G	47 (85.4)
22G	7 (12.7)
NA	1 (1.8)

[a]Post-surgery included: three colon surgery, six pancreatic and splenic surgery
[b]Others included one appendiceal collection.
[c]According to AGREE classification.[9]
IQR, interquartile range; M, male; SD, standard deviation; WON, walled-off necrosis.

mean size of the collections was 63.3 ± 24.8 mm. The most frequent nature was pancreatic disease ($n=45$, 81.8%; including $n=32$ pseudocysts; $n=12$ walled-off necrosis; $n=1$ acute collection). All others were non-pancreatic collections ($n=10$) located close to the gastric cavity and included post-surgical collections ($n=9$) or inflammatory abdominal collection ($n=1$). The most frequently used needle size was 19 Gauge ($n=47$, 85.4%). The median follow-up was 629 days (IQR 389–877). The two most frequent indications were size enlargement ($n=16$, 29.1%) and abdominal pain ($n=15$, 27.2%). Other indications are shown in Supplemental Table S1.

Outcome analysis

Technical success was achieved in all cases (100%). Clinical success was achieved in 42 (76.4%; 95% CI, 65.5–87.3) patients. Most of the successful EUS-guided SPAs were done in a single session ($n=37$; 88%) but in five cases (12%) a second session (different day) was required.

Factor analysis related to clinical success is detailed in Table 2. No factors associated with clinical success were encountered. However, a nonsignificant trend for success was detected for noninfected collections (63.6 vs 84.8%; $p=0.07$) and size (mean ± SD, mm: 60.2 ± 22.9 vs 73.8 ± 29; $p=0.09$).

All but one of the failed cases underwent salvage interventional approach (12 of 13 failed cases): (i) endoscopically in 5 (41.6%), with transmural drainage in 4 (DPS *n*-1; LAMS *n*-3) and one retrograde transpapillary drainage; (ii) percutaneous intervention in five patients (41.6%), and (iii) surgery in two patients (16.6%). One patient with an acute necrotic collection was ineligible for a salvage intervention due to respiratory status and finally passed away. At the time of the EUS–SPA, the immature (<15 day) pancreatic collection was considered unfit for transmural drainage, and no optimal window was encountered for percutaneous drainage. More details are provided in Supplemental Table S2 and Figure 3.

The median time from index EUS–SPA to salvage treatment was 21 days (IQR 5–61.7); 9 out of 12 patients (75%) were treated within the 3 months following EUS–SPA, and the other three patients later than 3 months (Supplemental Table S3).

All cases requiring a salvage therapy approach ($n=12$) after a failed EUS–SPA showed clinical improvement, and no other therapeutic approach was required.

A flowchart showing clinical outcomes of all included cases is provided in Supplemental Figure S3.

Related AEs

Two AES related to the EUS–SPA were detected in two patients (3.6%). One developed post-puncture gastrointestinal bleeding which required radiology intervention (grade IIIa, AGREE classification). The other case presented post-puncture abdominal pain which required admission and antibiotics therapy; the patient was discharged after 3 days (grade II, AGREE).

Long-term recurrence

During the period of follow-up, 5 (5/55 = 9%) patients presented a recurrence on imaging. All of them were pancreatic pseudocysts. Two of these five cases required EUS-guided TMD (with LAMS) as an interventional approach. Median follow-up in this subgroup was 680 days (IQR 395–1009, Table 3).

Follow-up of failed cases

Only one patient presented symptomatic recurrence of collection (new onset of abdominal pain) after EUS-guided TMD with LAMS as salvage interventional approach of an initial failed EUS–SPA. This case was re-treated with EUS-guided TMD with LAMS, and a second LAMS was placed.

No other recurrences were identified. Median follow-up in this subgroup was 404 days (IQR 103–693). (Supplemental Figure S3).

Table 2. Analysis of potential factors related to clinical success ($n = 55$).

Qualitative variables	Success (%)	*p*
Sex, *n*		0.53
Male, *n*-34	73.5	
Female, *n*-21	81	
Etiology (pancreatic/non-pancreatic), *n*		0.60
Pancreatic, *n*-45	77.8	
Non-pancreatic, *n*-10	70	
Microbiology, *n*		0.07
Positive, *n*-22	63.6	
Negative, *n*-33	84.8	
Needle size, *n*		0.23
19G, *n*-47	72.3	
22G, *n*-7	100	
Quantitative variables	Success, Yes or no	
Age, mean ± SD (years)	55.4 ± 12.3 vs 58 ± 13.2	0.51
Collection size, mean ± SD (mm)	60.2 ± 22.9 vs 73.8 ± 29	0.09

F, female; M, male; SD, standard deviation.

Discussion

This is a retrospective series that evaluated the efficacy of EUS–SPA as a first-line non-stenting strategy for the treatment of selected symptomatic and non-large abdominal collections. Our study shows clinical success in almost three-quarters of the patients, which, in terms of clinical practice, means this treatment could obviate the need for stent placement and its related hospitalization and morbidity.

The most common approaches in the management of symptomatic abdominal collections are endoscopic techniques (transmural drainage with stent insertion vs ERCP transpapillary stent), percutaneous drainage, and surgery. In Supplemental Table S4 includes comparative data between the different modalities (endoscopic, percutaneous,

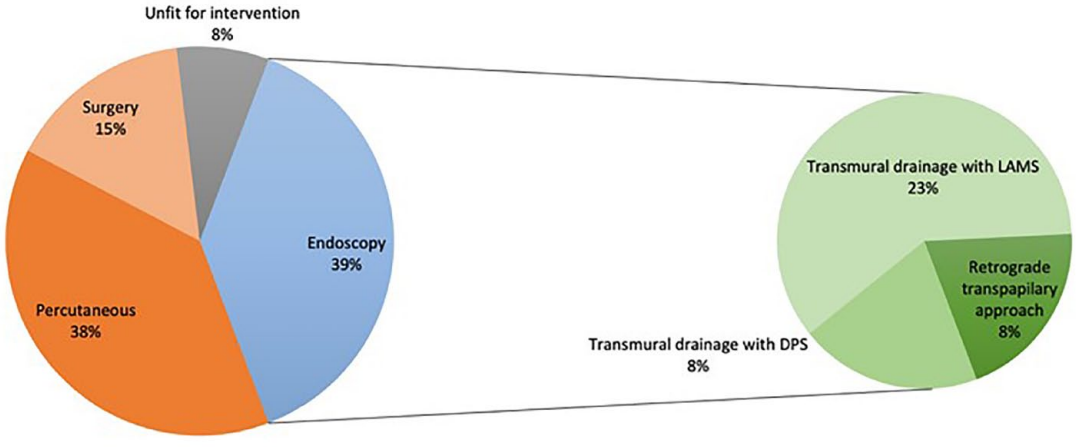

Figure 3. Management of patients with clinical failure of EUS-guided SPA.
EUS, Endoscopic ultrasound; SPA, simple puncture-aspiration.

Table 3. Recurrence of abdominal collection for patients with clinical success.

Successful group	**(*n* = 42)**
Collection recurrence,[a] *n* (%)	5 (11)
Required intervention or treatment[b]	2 (4.7)
Median of follow-up, days (IQR)	680 (395–1009)

[a]All recurrent collections were pancreatic pseudocysts (three chronic pancreatitis).
[b]Two cases required endoscopic ultrasound-guided transmural drainage using lumen-apposing metal stent.
IQR, interquartile range.

surgery), showing the different safety rates, favoring the less invasive intervention. However, selection of the approach depends on several factors: collection features, clinical symptoms, and medical team criteria.[1,2]

The collection features include size, location, suspicion of infection, and ductal communication (in pancreatic collections). Postoperative abdominal fluid collection can be managed with a percutaneous approach or with EUS-guided interventions, although the latter is less frequently reported.[4,10] The management of pancreatic fluid collections has been widely reported in recent years, and the endoscopic approach most commonly used is transmural stenting with DPS or LAMS.[1,11,12]

A minimally invasive approach with complete content aspiration has previously been described.[6,7] The first evidence of a simple and complete aspiration was from a radiology group that performed complete percutaneous aspiration and compared it to catheter drainage of sterile fluid collections in patients with acute pancreatitis. For nearly 50% of cases treated with complete single aspiration, this was not enough, and another approach was also required (percutaneous drainage or surgery), but in the other half of patients, a more aggressive approach could be avoided.[6] In this setting, although the sterility of the collection has been confirmed, many of these catheters are left in place for several weeks.[2,6] This prolonged and chronic catheter often leads to colonization of the collection, requiring several tube changes and hospitalization for catheter problems.

Despite this technique is not novel, most of the reported studies are published in journals of radiology.[5,6] To date, there are few reports about the EUS–SPA technique, as some case reports or retrospective case series with a lower number of included patients.[7] Ardengh et al. published a series of EUS-guided complete aspirations of sterile pancreatic fluid collections ($n = 33$), of less than 50 mm in size and compared this to a stent drainage group. They showed collection recurrence of 18% in the single-aspiration group against 4.5% in the stent group, although complications were described in 10% of patients in the stent group as opposed to none in the aspiration group. In the present study, the clinical success was higher, and few AES were reported. It must be noted that the mean size was 2 cm larger in our study. Furthermore, the Brazilian study included as a criterion for treatment collection persistence of longer than 6 weeks following the last acute pancreatitis episode.[7]

In our study, this conservative approach was applied in a quarter of all treated abdominal collections. In most of the patients, this strategy was sufficient and effective, as no further interventions were necessary. Of course, some patients treated in this manner required a second attempt, but the savings in transmural stent insertion or percutaneous drainage (with the need for catheter care) justifies this option in selected cases with an appropriate clinical setting. However, in any case, these patients must be followed up closely as a quarter of them in our study needed another attempt or a more aggressive approach.

Management of infected collections can differ from sterile collections. Clinical success in abscess or infected pancreatic collections is the removal of the infected content in the setting of a potential sepsis. However, the clinical impact of drainage in sterile fluid is a different scenario. Many of these collections can probably left alone as they will resolve spontaneously.

In the present study, there was a tendency favoring noninfected and lower-size collections. This means that infected collections may not be the most appropriate candidates for this proposed approach. The same concept for collections with a considerable size.

It must be noted that recurrence in our study (9%) was lower than expected, and similar to the recurrence rate after EUS-guided transmural drainage of pancreatic collections. All five recurrent collections were pancreatic pseudocysts, and three of them were related to chronic pancreatitis. Surely, a potential ductal disruption may explain some of these cases. However, the heterogeneity

of the included collections does not allow us to provide a solid explanation; a prospective study might clarify these findings.[1,3]

In our opinion, this non-stenting strategy using the EUS-guided SPA that might be proposed in selected abdominal collections and seems to be safe and useful in cases where transmural stenting is demanding and could be associated with morbidity. For example, for abdominal collections of small-size, the existence of significant interposal vessels between the target and EUS-transductor, or immature non-well encapsulated collections, this technique might be a useful option, even, if needed, as a step-up for transmural stenting in case of collection reappearance. But as a step-up strategy, these patients must be followed closely as a non-negligible number will need another attempt or a more aggressive approach.

However, some questions remain: Does the use of a thinner needle (22-G) really reduce the risk of bleeding with similar safety? What is the ideal collection size to recommend for a non-stenting approach as first-line? To address these questions and their concerns, prospective studies are needed.

This study has some limitations, mainly owing to its retrospective design. First, potential variation between the two centers with a potential population bias cannot be excluded. Second, the variability of the endoscopist criteria in selecting cases for use of EUS–SPA as a first-line strategy may have imposed a selection bias on the study population. Third, the lack of a standardized protocol with no specific follow-up implies a lack of information on follow-up, associated with a possible failure to catch some AEs. Lastly, the sample size was limited, although larger than previous reports.[7] Among the strengths of the study is the new and relevant information about an easy, not challenging, and safe technique that it offers.

Conclusion

In conclusion, EUS-guided SPA seems to be effective and safe. In our opinion, it may be considered for a selected group of abdominal collections, preferably noninfected and with limited size. This non-stenting step-up strategy might be a viable option to obviate having to use a more aggressive strategy (stenting) with no concomitant worsening of the clinical course of patients.

Declarations

Ethics approval and consent to participate

The study was approved by our institutional review board (*Comitè d'ètica de la investigació amb medicaments, Hospital Universitari de Bellvitge, L'Hospitalet Llobr., Barcelona*; ref. approval No. PR240/2021, June 23, 2021), and was designed in accordance with the ethical guidelines of the World Medical Association Declaration of Helsinki. All patients provided written informed consent before the procedure.

Consent for publication

Not applicable.

Author contributions

Julio G. Velasquez-Rodriguez: Data curation; Formal analysis; Investigation; Methodology; Resources; Supervision; Validation; Writing – original draft.

Carme Loras: Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Writing – review & editing.

Sandra Maisterra: Data curation; Formal analysis; Supervision; Writing – review & editing.

Juan Colán-Hernández: Data curation; Investigation; Supervision; Writing – review & editing.

Juli Busquets: Investigation; Methodology; Writing – review & editing.

Joan B. Gornals: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Resources; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

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Competing interests

J.B.G. is consultant for Boston Scientific and has received a Fujifilm grant. J.G.V. is a PhD student at the Faculty of Medicine, University of

Barcelona, and this paper is part of his doctoral project; J.B.G. acts as his PhD supervisor. C.L. received a speaking fee from Boston Scientific and is a consultant with Fujifilm. The remaining authors declare that there is no conflict of interest.

Availability of data and materials

Data are available on reasonable request. Please contact J.B.G. (jgornals@bellvitgehospital.cat) or J.G.V. (jvelasquez@bellvitgehospital.cat) who will review all requests.

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Supplemental material

Supplemental material for this article is available online.

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Abbreviations/Acronyms

AE	Adverse event
CT	Computed tomography
DPS	Double-pigtail plastic stent
ERCP	Endoscopic retrograde cholangio-pancreatography
EUS	Endoscopic ultrasound
FNA	Fine needle aspiration
LAMS	Lumen-apposing metal stent
MRI	Magnetic resonance imaging
SD	Standard deviation
SPA	Simple puncture-aspiration