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Original Article

Postoperative abdominal collections drainage: Percutaneous versus guided by endoscopic ultrasound

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Background and Aim: Postoperative fluid collections (POFC) have high mortality. Percutaneous drainage (PD) is the preferred treatment modality. Drainage guided by endoscopic ultrasound (EUS-GD) represents a good alternative. The aim of the present study was to compare clinical success and complication rates of EUS-GD versus PD.

Methods: Data collected prospectively were analyzed in a retrospective manner. Patients with POFC from October 2008 to November 2013 were included. All collections were drained percutaneously or by EUS-GD.

Results: Sixty-three procedures in 43 patients with POFC were analyzed; 13 patients were drained using EUS-GD and 32 patients with PD. Two patients assigned initially to the PD group were reassigned to EUS-GD. Surgery procedures most often related to the collections were intestinal reconnection, distal pancreatectomy, biliary-digestive bypass, and exploratory laparotomy. Technical success (100% *vs* 91%; $P = 0.25$), clinical success (100% *vs* 84%; $P = 0.13$), recurrence (31% *vs* 25%; $P = 0.69$), hospital stay days (median 22 *vs* 27; $P = 0.35$), total costs (8328 ± 1600 USD *vs* 11 047 ± 1206 USD; $P = 0.21$), complications (0% *vs* 6%; $P = 0.3$), and mortality (8% *vs* 6%; $P = 0.9$) were each evaluated in the EUS-GD and PD groups, respectively. In the PD group one death was related to the procedure.

Conclusions: EUS-GD is as effective and safe as PD in patients with POFC. The advantage of not requiring external drainage and a trend to higher clinical success and lower total costs must be considered.

Key words: abdominal collection, endoscopic ultrasound-guided drainage, endoscopy treatment, postsurgical collection, radiology intervention

INTRODUCTION

POSTOPERATIVE FLUID COLLECTIONS (POFC) are a significant cause of morbidity following intra-abdominal surgical procedures.[1,2] POFC may be asymptomatic, but some can lead to severe pain, gastric outlet obstruction, intra-abdominal infection and sepsis. Conservative management of POFC may be effective but some cases require additional interventions, such as percutaneous drainage (PD), EUS-guided drainage (EUS-GD), or surgical treatment.

Undrained abdominal collections have a mortality of between 45% and 100%. Surgical drains are associated with a high mortality rate of 20–40%. Currently, PD is the most common treatment with good success (80–100%) and mortality (1.4–15%) rates.[2] However, percutaneous catheters require frequent monitoring of fluid output to determine appropriate timing of catheter removal, regular flushing of the catheter to maintain patency, may require catheter changes at intervals, and often require visiting nurse services, generating higher costs and significant deterioration in quality of life (QOL).

EUS-GD has been shown to be a safe and effective method for draining fluid collections that result from acute pancreatitis, and recent studies have demonstrated the safety and efficacy of EUS-GD in patients with post-surgical POFC following distal pancreatectomy and other surgical procedures,[3–7] However, there are scarce data regarding the clinical success rate and complications in POFC secondary to other etiologies distinct from pancreatic surgeries.

The aim of the present study was to compare the success and complication rates in the treatment of POFC of EUS-GD versus PD.

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METHODS

DATA COLLECTED PROSPECTIVELY from October 2008 to November 2013 were analyzed in a retrospective manner. Patients with symptomatic abdominal collections because of abdominal surgeries and EUS-GD and/or PD were included. Patients with incomplete records, collections unrelated to a surgical procedure, and patients who went directly to surgery were excluded. All patients gave their written informed consent before the procedure and all were evaluated routinely with a contrast-enhanced computed tomography (CT) scan prior to the procedure. Demographics and baseline characteristics, including age, sex, type of abdominal surgery, and histopathological diagnosis were recorded. Follow-up data were obtained from review of the electronic medical records.

Endoscopic ultrasound-guided drainage

Those patients treated with endoscopic drainage were intubated and, in cases where they were not previously on antibiotics, received 1 g i.v. ceftazidime 30 min before the procedure. A convex linear-array echoendoscope was used and, once POFC was identified, it was accessed using a 19-gauge needle (Echo-Tip; Wilson-Cook Medical, Inc., Winston Salem, NC, USA). Collection aspirate was sent for microbiological cultures and a 0.035-inch guidewire was inserted through the needle into the collection with fluoroscopic guidance. After removal of the needle, we used a needle knife inserted over the guidewire to create a larger fistula. Finally, the gastric/duodenal wall was dilated up to 12–15 mm using a wire-guided balloon and two double pigtail plastic stents (7 Fr and 4 cm) were deployed for drainage. The procedure was done in both inpatients and outpatients. In the case of outpatients, they were observed at least every 4 h and discharged once they were awake and asymptomatic.

Based on clinical criteria and current information, the two endosonographers in our hospital (FTA and MARL) determined that all patients with EUS-GD of POFC had one CT at the 6–8–week follow-up evaluation or before if considered clinically necessary.

Percutaneous drainage technique

Cross-sectional imaging was carried out and prophylactic broad-spectrum antibiotics were given before all procedures. Using real-time ultrasound or CT guidance, a 21-gauge needle was placed percutaneously into the POFC and fluid was aspirated. A 0.018-inch guidewire was advanced into the collection, and either a Micropuncture introducer or a Neff set (Cook Medical) was used to convert to a 0.038-inch guidewire. The tract was sometimes dilated, and then either an 8.5- or a 10.2-Fr drainage catheter was placed into the fluid collection. The collection was emptied as completely as possible, and then post-drainage imaging was carried out. Catheter exchange or removal was based on clinical improvement as well as drainage catheter output, catheter malfunction or dislodgement, and evidence of persistent fluid on repeat imaging. Catheter removal was at the discretion of the radiologist.

Definitions

Technical success was defined as successful location of the collection and placement of drainage catheter or prosthesis. Clinical success was defined as clinical and radiological improvement in the collection without requiring an alternative drainage procedure or surgery initially. Complications were classified as related to: (i) procedure (gastrointestinal perforation, bleeding, bacteremia, pneumothorax, hemothorax); and (ii) catheter (malposition, obstruction, accidental release, breakage). We considered complications as follows: perforation was diagnosed when pneumoperitoneum was evident on imaging studies associated with peritoneal signs. Bleeding was defined as any hemorrhagic event that required endotherapy, blood product transfusion, or inpatient observation. Infection was considered if any septic event occurred after the initial endoscopic drainage and was caused by contamination of the POFC, proven by new-onset fever, positive blood cultures, or by positive fluid cultures obtained at endoscopic revision.[56] Stent migration was defined as the need to retrieve a stent from within the POFC or the enteral lumen.[7]

Treatment failure was defined as symptomatic persistent collection that required further intervention. Recurrence was defined as a collection that recurred after removing the drains with initial resolution. Re-intervention was defined as the need for repeat PD or endoscopy owing to persistent symptoms in association with a residual POFC that was not less than 50% of the original size on follow-up imaging

Statistical analysis

Continuous variables were expressed as means and SD. Categorical data were expressed as absolute numbers and percentages. Differences between groups were analyzed for categorical variables with the chi-squared test, except where the frequency was less than 5, in which case Fisher's exact test was used. For continuous variables, analysis with the Mann–Whitney *U*-test was done. We considered $P < 0.05$ as statistically significant. Statistical analysis was done with SPSS version 20.0 for Mac (SPSS Inc., Chicago, EEUU).

RESULTS

A TOTAL OF 78 patients were initially evaluated and 35 were excluded (Fig. 1). A total of 63 procedures in 43

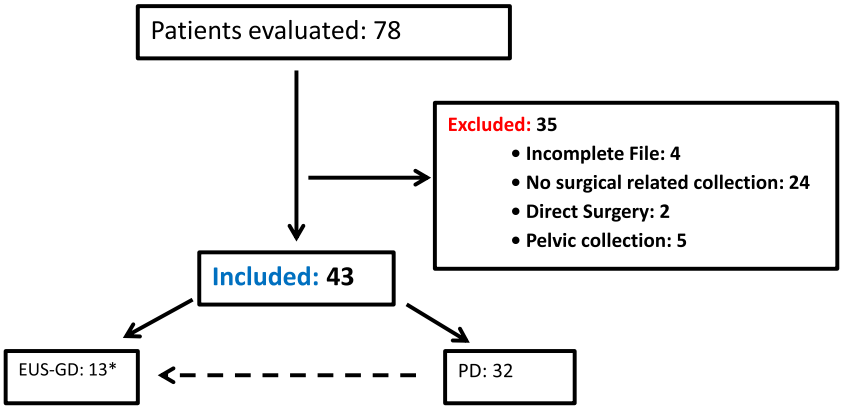

Figure 1 Patient collection diagram. †Two patients initially in the percutaneous drainage (PD) group were reassigned to the endoscopic ultrasound-guided drainage (EUS-GD) group as a result of failure of initial treatment (1) and recurrence of the collection (1).

EUS-GD: drainage guided by endoscopic ultrasound; PD: percutaneous drainage

patients with POFC were analyzed; 13 patients were drained endoscopically with EUS guidance and 32 patients with PD. Two patients assigned initially to the PD group were reassigned to the EUS-GD group: one as a result of failed treatment and the other because of recurrence of the collection. There were 26 (60.4%) men and 17 (39.6%) women with a mean ± SD age of 49 ± 15.7 years. Table 1 summarizes the baseline clinical characteristics and types of surgery of the included patients according to treatment group. Fluid culture was positive in 18 of 33 collections (54.5%) from patients previously treated with antibiotics and in four of 10 collections (40%) from patients with no antibiotic treatment.

Table 1 Baseline clinical characteristics and initial surgical procedures of included patients according to treatment group

Characteristic	EUS-GD, *n* = 13 (%)	PD, *n* = 32 (%)	*P*-value
Male	6 (46.1)	20 (62.5)	0.25
Age, years†	41 (21–84)	52 (21–83)	0.19
No. procedures†	1 (1–3)	1 (1–4)	0.89
PFC size, cm†	6.5 (4–20.8)	7.6 (4–23)	0.92
Surgery type			0.50
Intestinal reconnection	3 (23.1)	8 (25.0)	
Distal pancreatectomy	3 (23.1)	2 (6.2)	
Biliary-digestive bypass	2 (15.3)	3 (9.4)	
Exploratory laparotomy	3 (23.1)	6 (18.8)	
Whipple	1 (7.7)	3 (9.4)	
Appendectomy	–	1 (3.1)	
Cholecystectomy	–	3 (9.4)	
Hepatectomy	–	1 (3.1)	
Splenectomy	–	2 (6.2)	
Gastric bypass	–	3 (9.4)	
OLT	1 (7.7)	–	

EUS-GD, endoscopic ultrasound guided drainage; OLT, orthotopic liver transplantation; PD, percutaneous drainage; PFC, pancreatic pseudocyst.
† Expressed as median (range).

EUS-guided drainage

A total of 13 patients with 16 procedures underwent EUS-GD, including two patients who had previous PD. The route of drainage was transgastric in 14 of 16 (87.5%) collections, and transduodenal in two (12.5%). The stents remained *in situ* for an average of 56 (range 42–63) days.

Technical success was achieved in 13/13 (100%) patients. No patient was lost to follow up. Clinical success was achieved in all (13/13; 100%) patients. Four (30.7%) patients had recurrence and three (23.1%) patients required surgery. Of the patients with recurrence, two underwent surgery without a new EUS-GD or PD, one patient had one more EUS-GD, and one patient had two more EUS-GD before surgery; none had PD. Median number of procedures in the EUS-GD group was one.[1–3]

Of the two patients reassigned to the EUS-GD, both were initially clinical success. The first patient only needed one EUS-GD procedure. The second patient have recurrence after removal of the drains and needed two more EUS-GD procedures and finally underwent to surgery.

No complications related to EUS-GD were reported. One patient died because of immunosuppression secondary to chemotherapy and septic shock because of pneumonia.

Percutaneous drainage

A total of 32 patients with 47 procedures underwent EUS-GD, including the two patients who were reassigned to EUS-GD. Technical success was achieved in 29/32 (90.6%) patients. No patient was lost to follow up. Clinical success was achieved

in 27/32 (84.4%) patients. Eight (25.0%) patients had recurrence and three (9.4%) patients required surgery. Of the patients with recurrence, three underwent surgery without a new PD or EUS-GD, one patient had one more PD, two patients had two more PD, one patient was reassigned to EUS-GD, and one patient had three more PD before surgery. The drainage catheter remained *in situ* for an average of 32 (range 6–295) days.

Two patients had complications related to the procedure: one patient had a colonic perforation related to the catheter and one patient suffered pneumothorax and posterior empyema. Two patients died: one as consequence of colonic perforation, and one because of septic shock related to infectious endocarditis.

Statistical differences in main outcomes between the group with endoscopy drainage and that with PD are shown in Table 2.

DISCUSSION

IN THE PRESENT study, we observed that EUS-GD is at least as effective and safe as PD in patients with POFC, with the advantage of not requiring external drainage. A positive trend to EUS-GD is shown regarding its higher clinical success, lower complication rates, less mortality related to the procedure, shorter hospital stay and lower total costs.

The use of EUS-GD is increasing; initially used in the management of pseudocysts secondary to acute pancreatitis, numerous studies have shown long-term resolution with minimal complications. [3568] Because of its high-success rate in this scenario, EUS-GD of POFC has been recently reported. Varadarajulu *et al*. reported their experience of transmural EUS-GD for the management of peripancreatic collections after distal pancreatectomy with a technical and clinical success rate of 100% without complications.[3] In a comparative study, Kwon *et al*. reported very good success and a low complication rate of EUS-GD compared to PD.[1] Azeem *et al*. compared endoscopic versus PD of pancreatic fluid collections after pancreatic tail resection. Technical success, clinical success, recurrence rates and adverse events were similar between the two modalities; however, patients with endoscopic treatment had a shorter hospital stay (2 days *vs* 5.5 days, $P = 0.04$) and fewer CT scans (median 2 *vs* 3, $P = 003$).[9] In another study, Gupta *et al*. retrospectively evaluated EUS-GD for 49 postoperative collections in 43 patients. Overall clinical success at the end of follow up was 90%.[10]

Table 2 Statistical differences in main outcomes between the group with endoscopy drainage and that with PD

	EUS-GD, $n = 13$ (%)	PD, $n = 32$ (%)	*P*-value
Technical success	13 (100)	29 (90.6)	0.25
Clinical success	13 (100)	27 (84.4)	0.13
Recurrence	4 (30.7)	8 (25.0)	0.69
Hospital stay, days	22 (8–61)	27 (8–99)	0.35
Need for surgery	3 (23.1)	3 (9.4)	0.25
Costs, USD	8328 ± 1600	11 047 ± 1206	0.21
Complications	0 (0)	2 (6.2)	0.30
Mortality	1 (7.7)	2 (6.2)	0.90

EUS-GD, endoscopic ultrasound guided drainage; PD, percutaneous drainage.

In the studies by Azeem and Kwon, the authors only included patients with postoperative fluid collections following pancreatic enucleation or distal pancreatectomy. The success and complication rates reported are similar to our data, despite our sample including patients with different surgical procedures such as intestinal resections and gastric bypass surgeries. This is a very important point because, with our data, the indications for EUS-GD are expanded and the importance of EUS in different settings besides pancreatic surgery is demonstrated. These results demonstrate the technical feasibility of EUS-guided drainage of virtually any POFC as long as it is adjacent to the gastrointestinal lumen and within the reach of an echoendoscope. In the study by Gupta *et al*., collections resulting from different surgeries (pancreatic surgery, bariatric surgery, splenectomy, liver resection, renal surgery) were also included; however, there was no comparison group included in the analysis.

The use of EUS-GD as a first-line therapy for patients with POFC is not the standard measure nowadays. According to our data and similar to previous reports, no complications or deaths related to EUS-GD occurred. Added to its high success rates, we consider this is a very good therapeutic method that may be considered as the first-line treatment in patients with surgical collections. Supporting this, we determined that percutaneous drainage has a similar success rate as EUS-GD; however, QOL is affected in patients with PD[11] and more hospital days and image studies are needed.[9] Surgical procedures are highly effective in these patients; however, a more invasive approach also adds to morbidity and costs.[11]

A clear trend to lower costs in our EUS-GD group is evident, although statistical significance was not reached, possibly because of the sample size. The total costs reported in the present study could also be different than those reported at other hospitals in other countries. We have to consider that the total costs in both treatment groups (endoscopic and PD) were calculated according to prices in a public institution, but the relationship is surely maintained and the cost in our institution may well reflect the cost in other Latin-American and developing countries.

Limitations of our study must be mentioned. First, the study was retrospective and, because of this, inclusion criteria for either of the groups were not clearly defined. This point could impact against the EUS results: in recent years, in our institution, EUS-GD is considered a primary approach to drainage by interdisciplinary staff (endoscopists, surgeons, radiologists), but, only a few years ago, EUS-GD was considered only in patients who were not candidates for other means of drainage. These patients often required more complicated procedures, with larger and thicker collections. Second, the sample size was relatively small; however, only one previous published study has a larger sample size.[10] It is important to conduct randomized studies to compare QOL and costs between EUS-GD and PD. We can suppose that if the patient does not have a catheter on the skin, suffers fewer skin infections, and is less in need of care, the QOL must be better. Regarding costs, we can infer that if fewer hospital days and fewer image studies are needed with EUS-GD, the costs must be lower.

In conclusion, EUS-GD is as effective and safe as PD in patients with POFC with the advantage of not requiring external drainage. A trend to higher clinical success, fewer complications, shorter hospital stay and lower total costs must also be considered.

CONFLICTS OF INTEREST

AUTHORS DECLARE NO conflicts of interest for this article.

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