Pancreatic pseudocyst drainage guided by endoscopic ultrasound

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Abstract
Pancreatic pseudocysts can be managed conservatively in the majority of patients but some of them will require surgical, endoscopic or percutaneous drainage. Endoscopic drainage represents an efficient modality of drainage with a high resolution rate and lower morbidity and mortality than the surgical or percutaneous approach. In this review we address the endoscopic pseudocyst drainage procedure with special emphasis on technical details.

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INTRODUCTION
Endoscopic ultrasonography (EUS) guided pseudocyst drainage has been widely used since it was first reported[1]. Endoscopic pseudocyst drainage has been developed in order to avoid the morbidity and mortality associated with surgical and radiological drainage. The success rate of endoscopic drainage ranges from 87%-97% with a complication rate of up to 34% and a mortality rate of 1%-2%[2,3]. These outcomes compare favourably with the complication rate of 35% and the mortality rate of 10% associated with the surgical treatment and the complication rate of the percutaneous approach of up to 60%-70%[4].

In this article we describe the technical steps we follow to perform EUS-guided pseudocyst drainage. Since EUS controlled drainage is only necessary in the transmural approach, the transpapillary technique is not described here.

TECHNIQUE
Basically, there are two possible techniques for performing EUS-guided drainage: the EUS-Endoscopy technique, where the EUS is used only to perform the initial puncture of the pseudocyst, and the EUS-single step technique, where the whole procedure relies on the EUS exploration.

EUS-ENDOSCOPY TECHNIQUE
As has been mentioned before, this technique requires the use of endosonography, endoscopy and fluoroscopy. We always do the exploration with the patient under general
anaesthesia and in a left lateral decubitus position using antibiotic prophylaxis with ciprofloxacin or levofloxacin. This antibiotic treatment is maintained for 7 d after the procedure. We like to start the exploration with the radial echoendoscope, in order to evaluate the diameter and characteristics of the pseudocyst. These include distance to the gut wall, presence of solid debris inside the cyst, portal hypertension vasculature, relationship of the cyst to the splenic artery, communication of the cyst with the pancreatic duct and presence of biliary disease such as common bile duct stones (Figure 1A and B).

Taking into account the radial EUS findings and previous radiological results, the best approach to drain the pseudocyst is decided. When the best choice is to perform a transmural drainage, we then introduce the linear array echoendoscope as far as the stomach or duodenum, and search for an adequate point to puncture. This point must not have intervening vessels and the distance between the gut lumen and the pseudocyst must be less than one centimetre.

Once the best point to puncture is identified, a 19 G needle (Echo-Tip, Wilson-Cook medical, Inc., Winston-Salem, North Carolina, USA) is introduced through the working channel of the endoscope. Afterwards, we proceed to puncture with the endoscope in a fixed and straightened position (Figure 2A and B). After removing the needle stylet, we aspirate at least 30 cc of pseudocyst contents and send specimen for culture and analysis for determination of amylase and CEA levels.

Afterwards, we introduce a guide wire (Jagwire, Boston Scientific Corp, Natick, MA, USA) through the needle and check with the ultrasonography and the fluoroscopy view that the wire is correctly placed inside the cyst (Figure 2C). Without losing the endoscope position we remove the needle, leaving the guide wire in place, and then introduce a biliary balloon dilatation catheter (Hurricane Rx, Boston Scientific Corp, Cork, Ireland) through the needle and placed through the fistula, connecting the pseudocyst and the gastric lumen (Figure 2E and F).

In order to insert more stents, we have to recannulate the fistula and again insert the guide wire into the cyst to be able to introduce a second stent or a nasocystic catheter. We repeat this manoeuvre as many times as the number of stents we want to place.

Normally we place no less than 3 stents, 10F diameter and 5-7 cm long (Figure 2G). When we decide to insert a nasocystic catheter because of the presence of solid debris inside the cyst, we use a 6F catheter (Nasal Biliary Drainage Set, Cook Medical, Limerick, Ireland) and perform nasocystic lavage with continuous perfusion of 1000-1500 cc of saline over 3-5 d (Figures 3 and 4A).

The patient resumes oral feeding several hours after the exploration and is discharged 24 h later if there are no procedure-related complications. Between 4 and 6 wk after the drainage procedure we perform a CT scan and remove the stents if the resolution of the pseudocyst is confirmed (Figure 4B).

**EUS-SINGLE STEP TECHNIQUE**

For performance of this technique there is a commercially available device for use with large-channel echoendoscopes without the need for any exchanges, using the Needle-Wire Oasis System. This is an all-in-one stent introduction system, containing a 0.035-inch needle-wire suitable for cutting current, 5.5F guiding catheter and a pushing catheter with a back-loaded straight stent (8.5 or 10F, 5 cm long).

This procedure can be performed with the patient under conscious sedation by using standard monitoring in the left lateral position. Intravenous broad-spectrum antibiotics must be used before and after the procedure. The optimal location for carrying out the procedure is the fluoroscopy suite, since in some cases the radiologic view can be helpful either for insertion of the stent at a better angle or for completing the drainage with cyst irrigation and/or additional stent placement.

First thing to do is locate the cyst with the linear array echoendoscope, looking for an optimal contact with the gastric or duodenal wall. Doppler assessment is included to eliminate interposition of large vessels. The needle-wire is then introduced into the intestinal wall without intervening vessels.
wall and the cyst wall is penetrated under continuous pressure and cutting current. Once inside the cyst, the internal rigid part of the needle-wire is removed and it becomes a soft wire that can be easily inserted into the cyst followed by the dilator catheter and finally the straight plastic endoprosthesis under endoscopic and ultrasound monitoring.

DISCUSSION

Transmural endoscopic pseudocyst drainage was initially described as a blind technique, without the aid of EUS⁶. Although some authors still support this classic endoscopic approach⁵, EUS guided drainage offers important advantages. It improves the safety of the procedure as the risk of bleeding is reduced by avoiding intervening vessels identified with the color doppler. It also increases the number of patients amenable for endoscopic drainage since non-bulging cysts are also amenable to drainage. This has been proved in a prospective study performed by Varadarajalu et al⁶, in which, the EUS-guided approach was successful in all patients with a rate of pseudocyst resolution of 95%, while the endoscopic blind approach was successful in only 57% of patients with a similar rate of pseudocyst resolution (90%). Noticeably, in this study, 43% of patients in whom the blind approach was attempted required an EUS-guided drainage because of failure of the blind procedure⁶. Furthermore, the only clinically meaningful episode of bleeding occurred with the blind endoscopic approach. Taking these results into account, and in agreement with other authors⁶,⁷, we think that the EUS guided procedure allows more accurate drainage of cysts, with a lower risk of complication.

In addition to its safety and therapeutic success rate, EUS also allows a diagnostic evaluation of the pancreatic cystic lesions. Thus, based on the EUS findings, the management plan is changed in 5%-9% of patients since EUS identifies other cystic lesions misdiagnosed as pseudocysts⁶-⁸.

From the technical point of view, the EUS-guided approach has two crucial steps. The first is the identification of an optimal point to puncture without intervening vessels and with a short distance between the cyst and the gut wall. Once this point is identified, the endoscope should be straightened as much as possible in a stable position. The second critical step is that once the puncture has been performed and the guide wire is curled inside the cyst cavity, the wall dilator must be introduced without losing the endoscope position and under ultrasonographic view. Once the dilator has been inserted through the parietal fistula, the ultrasonographic view is no longer needed, and the dilation and stent insertion can be made under endoscopic view. In our

Figure 2  Approach to drain the pseudocyst. A: In this fluoroscopic image the linear array echoendoscope is inside the gastric lumen in a stable and straightened position, with the needle coming out of the working channel; B: EUS image with linear array echoendoscope in which the needle can be seen inside the cyst once the puncture has been made; C: The guidewire is inserted through the needle and curled inside the cyst cavity; D: With deflation of the balloon dilator the pseudocyst contents spurs through the fistula into the gastric lumen; E: Fluoroscopic view of the first double pigtail stent inserted through the fistula connecting the gastric lumen and the cyst cavity (Dimensions of the stent: 5 cm long and 10 F diameter); F: Three double pigtail stents can be seen draining the cyst contents into the gastric lumen; G: The three double pigtail stents are placed transmurally. The gastric and cyst lumen can easily be seen on the X-ray image.
experience, it is normally possible to recannulate the
tubula with the echoendoscope in order to insert more
stents, although it is sometimes necessary to exchange
the echoendoscope for a duodenoscope.

The single step technique was first described in 1998
by Vilmann et al. and Giovannini et al. In a prospective
study, Kruger and co-workers evaluated the one-
step device for drainage of pancreatic pseudocysts and
abscesses (Giovannini Needle Wire Oasis, Cook Endos-
copy, Limerick, Ireland). Endoscopic stent placement
was successful in 33 of 35 patients (94%), whereas
repeated needle passages were unsuccessful in 2 cases.
No procedure-related complications, such as bleeding,
perforation, or pneumoperitoneum, were observed. All
subsequent complications, such as ineffective drainage
(9%), stent occlusion (12%), or cyst infection (12%),
were managed endoscopically. The overall resolution rate
was 88%, with a recurrence rate of 12%, during a mean
follow-up period of 24 mo. The author concluded that
the one-step EUS-guided technique with a needle-wire
device provides safe transmural access and allows effective
subsequent endoscopic management of pancreatic pseu-
docysts and abscesses.

Although the EUS-Endoscopy technique requires
both fluoroscopic and endoscopic viewing, we prefer this
technique to the EUS single step procedure. It allows the
operator to insert more stents through just one fistula, to
insert pigtail stents, to insert stents of a greater diameter,
or even to perform more aggressive treatments such as
endoscopic necrosectomy whenever there is solid de-
bris within the cyst cavity. Furthermore, new technical
developments allow the operator to insert several guide
wires in just one step making the insertion of several
stents easier. Cahen et al. reported that the majority

Figure 3 In this case, a
large cyst of 18 cm in
diameter with a horseshoe
morphology going down
bilaterally as far as the
pelvic cavity can be seen
on the CT scan.

Figure 4 The same patient as previous images.
A: The patient was treated with placement of
three transmural double pigtail stents, and a
thinner nasocystic drainage catheter because
of dense cyst contents; B: The pseudocyst has
disappeared after 4 wk with the stents. One of
the stents has migrated and the other two can be
seen communicating between the gastric lumen
and the collapsed cyst cavity. Both stents were
retrieved uneventfully and the patient remains
asymptomatic 6 mo later.
of major complications related to the endoscopic drainage of pseudocysts might have been prevented by using pigtail instead of straight stents, further supporting our preference.

There are still some questions unanswered regarding the endoscopic treatment of pancreatic pseudocysts: How many stents must be placed? What is the optimal duration of stent placement? Regarding the first question, we always try to insert a minimum of three 10F diameter/5-7 cm long pigtail stents. Whenever the pseudocyst content is dense or there is a suspicion of pseudocyst infection, we also insert a naso-biliary catheter. Regarding the second question, there are some data in the literature which suggest a lower pseudocyst recurrence rate in selected patients when the stents are not retrieved\(^3\), although more data are needed to draw a firm conclusion.

In summary, EUS-guided pancreatic pseudocyst drainage improves the safety of pancreatic pseudocysts endoscopic drainage and increases the number of patients suitable for this procedure by avoiding percutaneous and surgical drainage which are associated with higher morbidity and mortality. Therefore the EUS-guided procedure seems to be the best and safest technique for transmural endoscopic pseudocyst drainage, and it should be considered the first choice option.

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