Review Article

Nonfluoroscopic endoscopic ultrasound-guided transmural drainage of pseudocysts: A pictorial technical review

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ABSTRACT

Pancreatic pseudocysts (PP) are one of the important local complications of pancreatitis and can be treated by surgical, laparoscopic, percutaneous, or endoscopic methods. The endoscopic methods of drainage include transpapillary or transmural drainage or a combination of these two routes. The transmural drainage can be done using conventional duodenoscope without endoscopic ultrasound (EUS) guidance or under EUS guidance. The EUS-guided transmural drainage of PP is done under EUS and fluoroscopic guidance. We have earlier reported nonfluoroscopic EUS-guided transmural drainage of walled-off pancreatic necrosis. In this pictorial technical review, we will discuss in detail this method of nonfluoroscopic EUS-guided drainage of PP.

Key words: Endoscopic ultrasound, pancreatic pseudocyst, pancreatic duct, stent

INTRODUCTION

Pancreatic pseudocysts (PP) are one of the important local complications due to pancreatic duct disruption in both acute and chronic pancreatitis.[1] The pancreatic duct disruption leads to leakage of pancreatic juice, and this tends to get collected and enclosed by a nonepithelialized wall over a 4-6-week period to form pseudocyst.[1] The PP may be asymptomatic or may present with symptoms like pain, fever, jaundice, early satiety, loss of weight, bleeding, and vomiting due to gastric outlet obstruction.[1-3] The management of pseudocysts has evolved over last two decades because of development and innovations in the field of minimally invasive procedures. Initially, lot of emphasis was laid on the size of the pseudocysts with any cyst >6 cm in size being considered for drainage.[4] However, with better understanding of the natural history of PP, now only the symptomatic or infected pseudocysts are considered for drainage.[4]

The symptomatic PP can be treated by surgical, laparoscopic, percutaneous, or endoscopic methods.[5-8] Surgery has been the mainstay for the treatment of PP but with the advancement in the minimally invasive approaches, endoscopic drainage has largely replaced the surgical drainage because of excellent short- and long-term results, low cost, decreased hospital stay, and better quality-of-life.[5] The PP may be drained endoscopically through the transpapillary or transmural route, or a combination of the two routes.[1]

The transpapillary drainage involves insertion of a stent or nasopancreatic drain (NPD) through a major or minor papilla into the main pancreatic duct. This stent/NPD then creates a drainage route of lesser resistance through which the pancreatic juice flows

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into the duodenum and thus leading on to the healing of duct disruption and consequent pseudocyst. This route of endoscopic drainage is suitable for small (<6 cm) communicating pseudocysts and the best results are obtained in patients with partial pancreatic duct disruption that can be bridged by a stent or NPD.[9-13]

The transmural drainage of PP is achieved by placing stents or naso-cystic drain (NCD) into the pseudocyst through the endoscopically created communication between the pseudocyst and the gastrointestinal lumen.[1] The transmural drainage can be done using conventional duodenoscope without endoscopic ultrasound (EUS) guidance or under EUS guidance.[3,14] EUS guidance has an additional advantage of providing excellent visualization of the surrounding structures so as to provide real-time guidance to advance the needle safely into the pseudocyst cavity without inadvertent puncture of any intervening structures like blood vessels or collaterals. EUS-guided drainage has been shown to be better than conventional endoscopy-guided transmural drainage with better technical success and lesser occurrence of procedure-related adverse events.[14-17]

This EUS-guided transmural drainage of PP is done under EUS and fluoroscopic guidance. The EUS is needed for the guidance of the needle into the cyst cavity and the fluoroscopy is needed for confirming the access into the cyst cavity by injection of the contrast, for visualizing the coiling of the guide wire into the cavity and while deploying the stent or the NCD. We have earlier reported the results of nonfluoroscopic EUS-guided transmural drainage of walled-off pancreatic necrosis and shown that the above-mentioned steps can be done without fluoroscopy.[7] In this pictorial technical review, we will discuss in detail this method of nonfluoroscopic EUS-guided drainage of PP. The results of transmural drainage will not be discussed in this review, and the readers are requested to consult other reviews on this topic.[1,6]

PREDRAINAGE EVALUATION

The drainage procedure should be done by an experienced team at the center with adequate facilities and surgical as well as radiological back up. Before the drainage, the pancreatic fluid collection (PFC) should be clearly defined by cross-sectional imaging including its size as well as the relationship to surrounding structures. The cystic neoplasms as well as presence of pseudoaneurysms should be excluded. A special emphasis should be laid on determining whether a mature, complete cyst wall has formed, and the distance between the PP wall and gastrointestinal tract wall should be determined. There should be no contraindications for the procedure like coagulopathy or intake of oral anticoagulants. The supporting team should be cautioned for potential risk of aspiration because of initial puncture of the PP well in advance. Furthermore, before embarking upon the drainage procedure, it is important to differentiate walled off pancreatic necrosis (WOPN) from acute pseudocyst because standard endoscopic drainage has poor results in WOPN due to the presence of solid necrotic debris that is difficult to drain and these patients usually require aggressive endoscopic drainage with multiple stents or direct endoscopic necrosectomy.[18,19]

DRAINAGE PROCEDURE

The EUS-guided transmural drainage procedure is fairly standardized, but there are several variations at each step and all the pros and cons of these variations will be discussed. It is advisable to give antibiotics prior to the procedure, and the need of postprocedure antibiotics has to be individualized based upon the presence of infection and the efficacy of drainage. The procedure may be done under conscious sedation or general anesthesia but in either of the situation adequate steps should be taken to protect the airway. A linear echoendoscope is to be used for the drainage procedure.

Before starting the drainage procedure, adequate time should be spent on a diagnostic EUS carefully looking at differentiating features of pseudocyst from cystic tumors, presence and amount of solid necrotic debris, calculation of the distance between the cyst and the gastrointestinal wall and presence of any abnormal vessels, varices, or pseudoaneurysms.[4] The EUS should be performed carefully even if no abnormal vessels have been detected on cross-sectional imaging as EUS can detect small abnormal vessels missed on other imaging modalities.[20] Once the PP has been found to be fit for endoscopic drainage, the site for puncture should be selected.

Selection of site for needle puncture

The best site for gastroduodenal puncture should be identified on EUS taking into account the following factors:[21]

a. There should be no intervening abnormal vessels or collaterals [Figure 1].
b. The cyst wall should be well-approximated to the gastrointestinal tract wall with the combined wall

thickness of ≤10 mm although in some circumstances thickness up to 20 mm may be acceptable.[21] The site of least combined thickness should be selected as there is an increased difficulty in dilating tracts that have been created within thick walls, and many times electrocautery would be required for this purpose (see later).

c. The puncture site should be preferably at the center of the PP rather than at the edge as this decreases the risk of perforation [Figure 2].
d. If possible, the echoendoscope should be in the short route as it makes the passage of accessories through the scope much easier.

Needle puncture and initial dilatation of the tract

After selection of the site, the transmural puncture should be performed using a 19-gauge fine-needle aspiration needle under real-time EUS guidance [Figure 3a and b]. The tip of the needle must be carefully followed and once inside the cavity, the stylet should be removed, and the contents aspirated to confirm the correct position of the needle. The aspirated contents should be sent for biochemical analysis as well as the culture.

Once the collection is accessed, and position of the needle confirmed, any standard-sized guide wire is advanced into the collection under EUS guidance [Figure 4a and b]. The coiling of the wire can be easily seen under EUS. We use 0.035-inch guide wire as it is stiff, but these large diameter wires can be fairly tight in a 19-gauge needle and can be sheared also. To avoid shearing of guide wire one may use a smaller caliber guide wire or use a nonbeveled needle for puncture. The step of coiling the guide wire into the PP cavity without fluoroscopy is the most critical as without fluoroscopy there is a risk of the guide wire causing perforation of the cyst wall. The guide wire's entrance into the cavity should be well-visualized under EUS and once the tip of the guide wire is seen exiting the needle tip, the guide wire should be pushed slowly so that no more than 10 cm of the guide wire is pushed further. Although the tip of the guide wire is not so well-visualized as seen under fluoroscopy, the coiling of the wire can be appreciated under EUS.

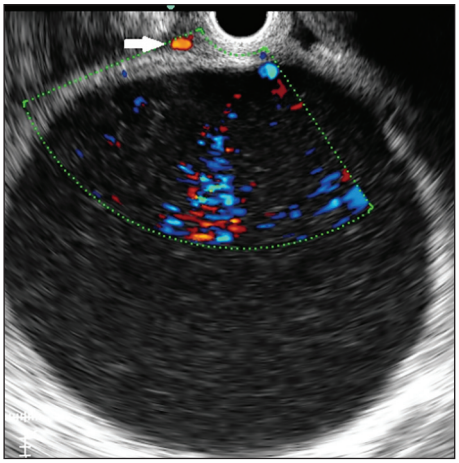

Figure 1. Endoscopic ultrasound evaluation of pseudocyst prior to drainage. A vessel is noted at the intended site of puncture on color Doppler (arrow)

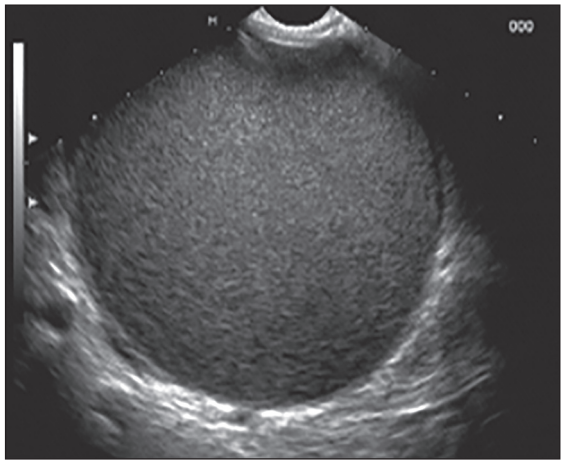

Figure 2. Prior to puncture, the whole pseudocyst should be visible under endoscopic ultrasound and the intended puncture should in the center of the pseudocyst

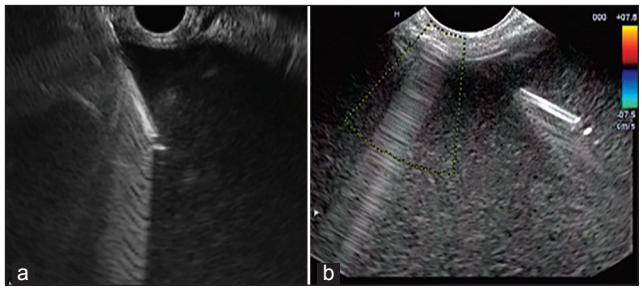

Figure 3. (a) Endoscopic ultrasound (EUS)-guided puncture of the pseudocyst using 19-gauge needle. (b) EUS-guided puncture of the pseudocyst using 19-gauge needle. Color Doppler is used to ensure blood vessel free tract

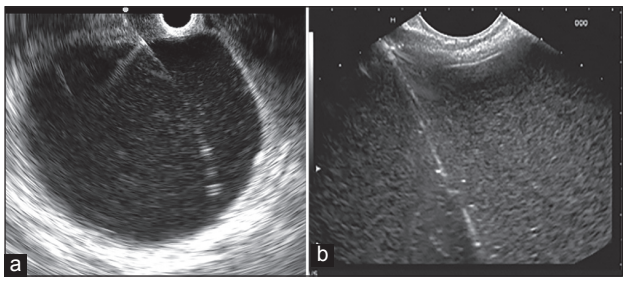

Figure 4. (a and b) The guide wire being pushed into the pseudocyst cavity under endoscopic ultrasound guidance

After securing the guide wire inside the cavity, the needle is exchanged, and the transmural tract has to be further dilated so as to allow the passage of dilating hydrostatic balloons. This initial enlargement of the tract can be achieved with or without electrocautery. The noncautery methods of dilatation include usage of endoscopic retrograde cholangiopancreatography (ERCP) cannula, sphincterotome, or a biliary balloon dilator. The methods using electrocautery are usage of a wire-guided needle knife, or a fistulotome. Either of these methods can be used for initial dilatation, and we prefer to use noncautery methods of dilatation, especially if the combined wall thickness of the cyst and gastrointestinal wall is less than 8 mm. We commonly use Biliary Balloon Dilatation Catheter for the initial dilatation of the tract [Figure 5a and b]. A 4 mm balloon (outer diameter inflation diameter) would be the preferred size for initial dilatation as this sized balloon passes easily through the needle tract. Sometimes, the combined wall thickness of the cyst and gastrointestinal wall is more, and none of the noncautery methods are successful in enlarging the transmural tract. In this situation, needle knife or a fistulotome has to be used. A fistulotome is preferred as it enlarges the tract over the wire whereas in wire-guided needle knife, the direction of the needle tip is not same as that of the guide wire and this can sometimes lead on to perforation. If wire-guided needle knife is to be used, we first attempt to dilate the tract using a biliary balloon. This creates a depression at the attempted site of dilatation and thereafter the needle knife catheter is snuggly pushed at this site. Once anchored into this depression, the needle is pushed out, and the cutting current passed. This ensures the dilatation at the intended site and decreases the risk of perforation. All these steps should be done under EUS guidance, and therefore, the echoendoscope should be kissing the gastrointestinal tract wall during all this procedure. The inflation of the biliary balloon can also be seen under EUS and thus the tract can be dilated under real-time guidance.

Hydrostatic balloon dilatation of the tract

After initial dilatation, the tract needs to be further dilated using hydrostatic balloons. The subsequent steps can be done either under endoscopic or EUS guidance. The balloon can be inserted into the cyst cavity under endoscopic guidance and thereafter, the dilatation performed under direct vision using endoscopic guidance [Figure 6]. This is the conventional way of performing endoscopic balloon dilatation, but it has the risk of loss of endoscopic vision and consequent displacement of the guide wire due to the release of a large amount of fluid from the cavity. The dilation can also be done under EUS guidance with the inflation of the hydrostatic balloon seen beautifully under EUS [Figure 7a and b]. The added advantage of this approach is that there is no risk of loss of vision as this procedure is done completely under EUS guidance. The size of the dilatation of the transmural tract depends upon the contents of PFC. In PP where the contents are predominantly liquid, 10-12 mm dilatation is sufficient.

Placement of stent or naso-cystic drain

Following successful balloon dilatation, the next step is to place stents or NCD to maintain the patency of the fistula tract. The advantages of NCD placement are:

a. It can be easily placed without fluoroscopy.
b. There is no risk of losing guide wire as a result of loss of endoscopic vision because of the gush of the fluid as its placement can be done under EUS guidance and does not require endoscopic vision [Figure 8].

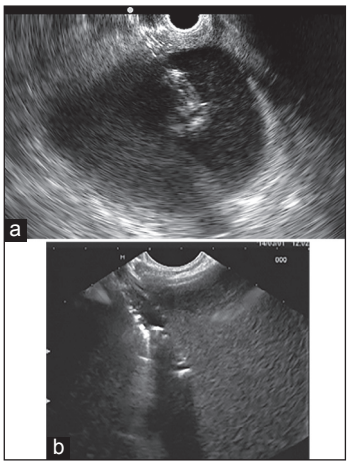

Figure 5. (a and b) Initial dilatation of the tract using biliary balloon dilator

Figure 6. Hydrostatic balloon dilatation of the transmural tract under endoscopic guidance

However, NCD placement is also associated with certain disadvantages:

a. It is associated with discomfort, and there is a risk of accidental dislodgement of the NCD.

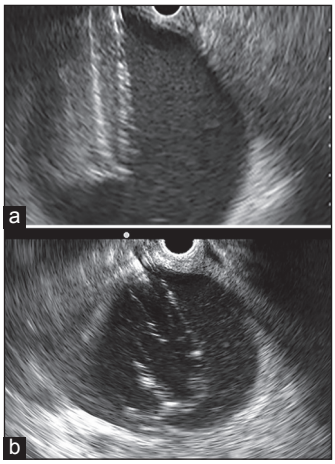

Figure 7. (a and b) Hydrostatic balloon dilatation of the transmural tract under endoscopic ultrasound guidance

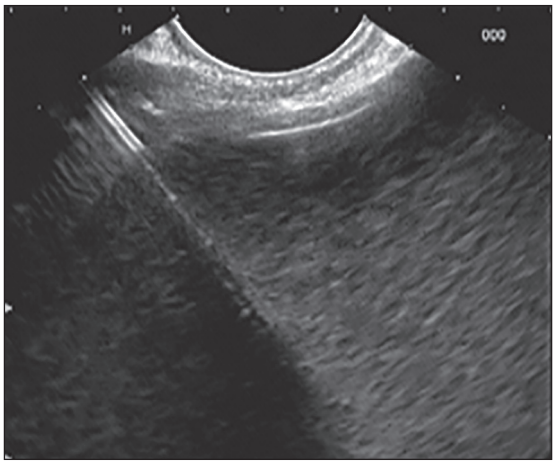

Figure 8. Naso cystic drain being placed in the cavity under endoscopic ultrasound guidance

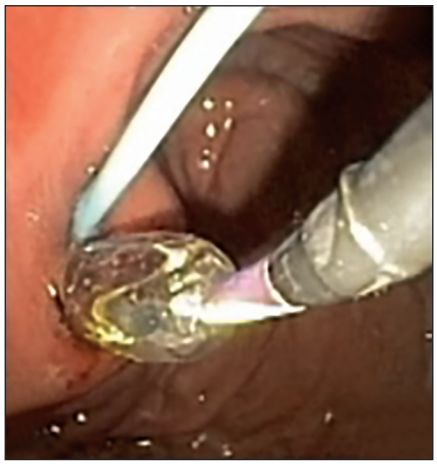

Figure 9. Transmural tract being dilated with naso cystic drain *in situ*

b. In disconnected pancreatic duct syndrome, to reduce the risk of recurrence of PFC's, the endoprosthesis has to be left indefinitely. This involves an additional endoscopic procedure for replacement of NCD with pigtail stents.

Deployment of stents without fluoroscopy is difficult, and there is a risk of losing the guide wire. We place NCD or stents during the initial procedure, depending upon the size of the PP. In PP, more than 8 cm in size, we initially place an NCD, as these cysts have a large amount of fluid that can make placing of stents without fluoroscopy difficult. Two or three days later, the NCD is replaced with stents under fluoroscopy using a duodenoscope. The tract may be dilated with NCD *in situ* for easier placement of stents [Figure 9]. In PP, less than 8 cm in size, stents are placed during the initial procedure only using an echoendoscope. Double pigtail stents with clearly visible endoscopic markers should be used in order to correctly deploy the stents.

CONCLUSION

We have described the details of nonfluoroscopic EUS-guided transmural drainage of nonbulging pseudocysts. This procedure appears to be safe and effective, and an added advantage of this procedure is that it can be done at the bedside and this would be especially useful for critically ill patients.

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