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Review Article

Recent development of endoscopic ultrasonography-guided drainage of pancreatic fluid collections

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ABSTRACT

Peripancreatic fluid collections (PFCs) usually occur as a local complication of acute pancreatitis. In the Atlanta classification revised in 2012, local complications are categorized into acute PFC, acute necrotic collection, pancreatic pseudocyst, and walled-off necrosis. The latter two are indications for drainage. With the development of endoscopic ultrasonography (EUS)-guided interventions, EUS-guided drainage of PFCs is now established as a standard treatment due to the advantages of lower cost, shorter hospital stay, and faster recovery. This article provides a brief introduction of PFCs and information on EUS-guided drainage of PFCs with a review of literature.

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Keywords: Drainage; Endosonography; Pancreatitis; Peripancreatic fluid collection

Introduction

While about 80% of acute pancreatitis (AP) is known to improve without complications only with conservative treatment, 20% of AP can progress to moderate or severe acute necrotizing pancreatitis.^{1,2} Local complications of AP usually refer to peripancreatic fluid collections (PFCs). In the Atlanta classification revised in 2012, local complications are categorized into acute peripancreatic fluid collections (APFCs), acute necrotic collections (ANCs), pancreatic pseudocysts (PPs), and walled-off necrosis (WON), each of which further classified to infectious or non-infectious.¹

The treatment of PFCs has been selectively performed among surgical, percutaneous, or endoscopic treatment depending on patients' condition, medical environment, clinician's experience, and skill level. Recently, with the introduction and development of endoscopic ultrasonography (EUS) interventions, EUS-guided drainage of PFCs has gradually become a standard treatment. This article provides a brief introduction of PFCs and information on EUS-guided drainage of PFCs with a review of literature.

Classifications of PFCs and Indications for Drainage

Revised Atlanta classification released in 2012 has been wide-

ly used for the definitions and classifications of PFCs.¹ AP can be subdivided into interstitial edematous pancreatitis and necrotizing pancreatitis, and PFCs as a result of its complication are classified into APFCs, PPs, ANCs, and WON as mentioned above. APFCs and ANCs develop within 4 weeks after interstitial edematous pancreatitis and necrotizing pancreatitis, respectively, which are not indicated for drainage due to the lack of definable wall encapsulating the collection.^{3,4} Therefore, the intervention should be performed at least 4 weeks after onset so that the wall would be mature and encapsulated.^{1,5,6} This could reduce complications after intervention. In a study of 242 patients, the longer the period from AP to drainage, the lower the mortality (0–14 days, 56%; 14–29 days, 26%; 29 days or more, 15%; $P < 0.001$).⁶ It was considered an indication for intervention if the size of PFCs were larger than 6 cm in the past. However, currently, treatment is not determined based on the size alone.

Drainage should be considered if symptoms such as general weakness, abdominal pain, and fever occur in patients with PPs. As mentioned above, the treatment is not determined solely based on the size of PPs. If the size of PPs continues to increase, the drainage procedure may be attempted, but if there are no symptoms, observation is warranted.⁷ Complications related to PPs include hemorrhage, infection, and gastrointestinal or biliary

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obstruction, so it is important to determine the appropriate time to perform drainage to minimize complications. In order to drain PPs, the wall must be mature enough, and it usually takes about 4–6 weeks from the onset of AP. There was a report that the risk of complications increases if drainage is delayed for more than 8 weeks.⁸ Similarly, drainage for WON should be considered when complications such as infection or obstruction develops. In addition, drainage is indicated if uncontrolled abdominal pain, loss of appetite, or weight loss persists. Infected PFCs generally require intervention. However, if the patients are clinically stable, conservative management with administration of appropriate antibiotics may be tried. Although, it is often difficult to know whether there is an infection due to severe inflammatory responses caused by pancreatitis itself in the early stage, it usually becomes distinguishable clinically in 2 to 4 weeks.

Drainage Methods for PFCs

If drainage for PFCs is indicated, surgical, percutaneous, or endoscopic interventions can be performed. Traditionally, surgical drainage was known to be effective for PPs with a success rate of 91%–97%.⁹ However, with the development of endoscopy and EUS, endoscopic (or EUS-guided) drainage has become a preferred treatment for PFCs as an initial treatment rather than surgical drainage. In comparative studies on treatment outcomes published so far, there is no significant difference of success and complication rate between the two methods.^{10–13}

Percutaneous drainage is a method of inserting tubes of 8–23 Fr through the retroperitoneum or peritoneum into the PFCs using ultrasonography or X-ray fluoroscopy.^{14,15} Few studies have directly compared between percutaneous and endoscopic drainage. In a retrospective study of 81 patients with PPs, the treatment success rate and the incidence of complications between endoscopic and percutaneous drainage were not significantly different. However, the re-intervention rate and hospital days were higher, and more abdominal imaging studies were required in patients undergoing percutaneous drainage.¹⁶ Therefore, endoscopic drainage is considered primarily for PFCs adjacent to the stomach or duodenum, while percutaneous drainage can be considered when endoscopic approach is impossible. Surgical treatment is reserved only for cases with no improvement after endoscopic or percutaneous drainage, or if bleeding is accompanied. A multidisciplinary discussion may be useful for the selection of an appropriate drainage method.

How Is EUS-Guided Drainage of PFCs Performed?

Endoscopic treatment for PFCs includes transmural and transpapillary drainage.^{10,17} When performing transmural drainage, EUS-guided drainage is preferred rather than endoscopic transmural drainage because an ideal puncture site can be identified using EUS.¹⁸ Intervening blood vessels also can be identified using EUS Doppler for the occurrence of bleeding to be prevented. A puncture is performed by selecting a location where the distance between the gastrointestinal wall and PFCs is the closest. In addition, EUS can be helpful in selecting an appropriate treatment method since it shows the amount of necrotic material in the PFCs.^{18–20} A randomized study compared the outcomes between EUS-guided and endoscopic transmural drainage, which reported that the success rate of EUS-guided drainage was superior (100% vs 33.3%, $P < 0.001$).²¹

The general procedure of EUS-guided drainage of PFCs is as follows. After puncturing with a 19-gauge needle, a stylet is

removed. A small amount of contrast medium is administered into the PFCs to evaluate whether the puncture has been properly performed by fluoroscopy. Also, the fluid of PFCs is aspirated to check whether the needle is properly inserted into the PFCs, and the characteristics of the aspirated fluid are identified. Then 0.025- or 0.035-inch guidewire is inserted into the PFCs through the inside of the needle. Inserting a cystotome or balloon to expand the puncture site is followed, and then a stent or nasocystic drainage tube is placed.²²

Stents Used in EUS-Guided Drainage of PFCs

Traditionally, plastic stents, especially 7-Fr double pigtail stents, have been widely used for EUS-guided drainage of PFCs.²³ In recent years, fully covered self-expanding metal stents (SEMSs) are increasingly used. Tube-shaped metal stents for endoscopic retrograde cholangiopancreatography were used in the past. Recently, metal stents specialized in drainage of PFCs became available.²⁴ In particular, lumen apposing metal stents (LAMs) with large diameters and trumpet-shaped ends were introduced.^{5,25,26}

Plastic stents have the advantage that they are inexpensive and can be easily removed even after a long period of time.²⁷ However, drainage may not be sufficient because plastic stents are small in diameter, which can result in an infection inside the PFCs. In order to overcome these disadvantages, multiple plastic stents or additional nasocystic drainage tubes are inserted during the procedure.^{24,28} However, multiple guidewires must be used to insert multiple stents, and it takes a lot of time.

SEMS have a larger diameter (8–16 mm) than plastic stents, so they are effective in draining PFCs with a lower risk of occlusion. In addition, it can reduce the steps and number of accessories required for each step, resulting in shortening the procedure time.²⁴ In particular, SEMS equipped with an electrocautery device can be inserted without additional accessories.²⁹ In addition, inserting a plastic stent cannot be reversed once the stent is inserted if any problem occurs. However, inserting SEMS can be easily reversed even in the middle of an inserting procedure.

Complications Associated with EUS-Guided Drainage of PFCs

Complications associated with EUS-guided drainage of PFCs reportedly occur in 5%–20% of the cases.^{30,31} Infection, bleeding, perforation, stent dislocation, pancreatic duct injury, and complications related to the use of sedatives may occur. In a study of 148 patients who underwent EUS-guided drainage of PFCs, 8 (5.4%) complications were reported, 2 perforations, 4 infections, 1 bleeding, and 1 stent dislocation.³² In another study, 18% of complication rate was reported.²⁰ Infections that occur after drainage are mostly caused by clogging of stents or the presence of undrained area. If a secondary infection develops or the existing infection worsens, another session of endoscopic treatment should be considered. If the inserted stent is the cause, it should be replaced with a new one. In some cases, a percutaneous intervention may be performed additionally.

Bleeding develops up to 20% of the patients undergoing EUS-guided drainage of PFCs.³³ It is reported to be common in procedures with LAMS.³⁴ Bleeding also occurs from a pseudoaneurysm caused by arterial injury during the process of stent insertion. If bleeding is suspected, computed tomography angiography is recommended. When a pseudoaneurysm is identified, angiographic embolization should be performed immediately. Venous bleeding or bleeding from the fistula may occur, but in most cases, it can stop naturally or by endoscopy. Most of the venous bleeding is

mild and easily controlled, but it can be severe in cases of splenic vein, portal vein, or variceal bleeding. A multidisciplinary approach including medical treatment with octreotide or surgery may be required in case of severe uncontrolled venous bleeding. For massive bleeding during the procedure, hemostasis using balloon tamponade should be attempted first, and additional treatment such as radiologic intervention or surgical treatment should be considered if necessary.

Perforations are reported with a frequency of about 5%, and can occur during or after the procedure.^{35,36} If a perforation by a stent is detected during the procedure, an esophageal fully-covered SEMS or a LAMS with a large diameter is inserted. The small amount of pneumoperitoneum found after the procedure mostly disappears by itself. As described above, most of the complications associated EUS-guided drainage of PFCs are managed by endoscopic or conservative treatment. However, in some cases, radiologic or surgical intervention may be required. Therefore, it is desirable to perform endoscopic drainage procedure when the support of interventional radiologists and surgeons is available.

To date, there have been no randomized controlled studies on prophylactic antibiotics prior to drainage, and there have been no high-quality studies on the class of antibiotics or duration of therapy. However, since drainage is a process that creates an artificial fistula in the gastrointestinal tract, internal organs are exposed to a contaminated environment, and infection occurring after procedure is one of the most common complications, prophylactic antibiotics administration is recommended by both European and American guidelines.^{3,5} Most of the previous studies were primarily on preventing infection of necrotizing tissues in AP, and dealt with various kinds of antibiotics.^{37–42} As high doses of second or third generation cephalosporin or carbapenem classes were used in most studies, it is thought that administration of these classes of prophylactic antibiotics would be helpful although the evidence is insufficient. There has been no study on how long the antibiotics should be maintained, but it is generally recommended to maintain for 3–5 days after the procedure.⁵

Removal of Inserted Stents

Criteria for the appropriate duration of stent placement for PFCs have not been determined. If it is confirmed that the PFCs are completely resolved on follow-up imaging, removal of inserted stents is recommended.⁴³ A longer duration would be required if infection or pancreas necrosis is accompanied. Because the stent may be dislodged into the intestine or intraperitoneal cavity if the period of stent placement is prolonged, it is necessary to check the condition of the stents or the loss of PFCs through regular imaging. The risk associated with stents removal is relatively low.⁴⁴ Long-term stent patency rate and stability are still unknown, so further studies are needed.

Conclusions

EUS-guided drainage of PFCs is now established as a standard treatment due to the advantages of lower cost, shorter hospital stay, and faster recovery compared with radiologic intervention or surgical treatment. With the development of EUS-guided interventions, there is a growing need for large-scale research on issues that have not been established yet, such as the need or duration of prophylactic antibiotics, the superiority of LAMS, and the optimal duration of stents placement.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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