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CASE REPORT

Endoscopic ultrasound-guided treatment of pancreatic fluid collections with lumen apposing metallic stents: lessons learned

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Abstract
Pancreatic fluid collections are common pancreatitis complications that frequently require drainage. Endoscopic ultrasound-guided placement of expandable lumen apposing metallic stents has recently emerged as an effective and less invasive treatment option. It is associated with less morbidity, lower costs, and faster clinical recovery than other therapeutic modalities. Nevertheless, this procedure may result in severe complications such as bleeding, buried stent syndrome, and prosthesis dislodgement (with perforation and peritoneal leakage). We performed 108 EUS-guided drainages with lumen apposing metallic stents for the treatment of pancreatic fluid collections with 8 complications and only two cases that required urgent surgical procedures resulting in one fatality. We present this two severe complications submitted to surgical treatment and discuss potential signs of alarm that must be taken under consideration before choosing a treatment modality.

Keywords Pancreatic cyst · Endoscopy · Ultrasonography · Prosthesis

Introduction

Pancreatic fluid collections (PFC) are usually complications of pancreatitis that, when symptomatic, require adequate drainage. The most important treatment options are the endoscopic, percutaneous, and surgical approaches [1]. While surgical treatment has been the standard approach to treat PFC for the last few decades, recent technological advances made the minimally invasive endoscopic and endoscopic ultrasound (EUS)-guided the preferred approaches. They offer a lower morbidity and less invasive treatment option associated with reduced hospital stay and costs [2, 3]. However, they have the disadvantages of significantly higher recurrence and complication rates than the classic surgical approaches such as cystogastrostomy, longitudinal pancreaticojejunal anastomosis, and surgical debridement [4].

In this context, the use of covered self expandable lumen apposing metallic stents (LAMS) placed under EUS guidance has emerged as a more effective option to the conventional plastic stents, as they allow for larger access for drainage and debridement with endoscopic instruments if necessary, reducing the necessity of multiple revisions [2].

Nevertheless, some problems are associated with EUS-guided drainage of PFC with LAMS, such as dislodgement of the stent, perforation, biliary obstruction, buried stent syndrome, and life-threatening bleeding [3, 5].

We describe two cases of PFC treated with EUS-guided insertion of LAMS that presented with severe adverse events and discuss the paramount necessity of endoscopists being fully aware of the potential complications of this procedure and how to recognize the initial signs of alarm to prevent these potentially fatal events. Informed consent form was obtained from the patient or relatives for both the cases.

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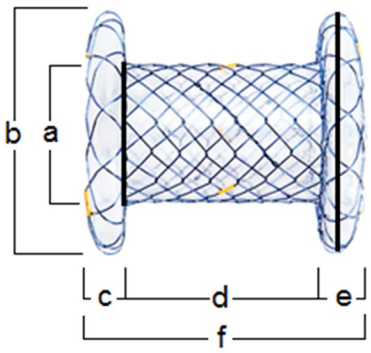
Case reports

Clinical case 1

A forty-eight-year-old male patient had been previously submitted to roux-en-Y gastric bypass 5 years before. After that surgery, the patient has became a heavy drinker and, as a result, presented a case of severe acute pancreatitis complicated with walled-off pancreatic necrosis (WON). The cystic lesion was located in the pancreatic head and measured 10.7 × 8.6 × 7.2 cm. One year after the acute pancreatitis episode, it caused biliary obstruction with extensive common bile duct dilatation (Fig. 1a). The patient was submitted to an effective EUS-guided drainage of the WON with an LAMS inserted through the gastric pouch (Fig. 1b–d). The stent used for the drainage was a Plumber ™ Biliary Stent (M.I.TECH, Seoul, Korea) with a total length of 30 mm, 12 mm stent diameter, and 24 mm bilateral anchor flanges diameter (Fig. 2). The initial procedure was uneventful. Two more endoscopic revisions were performed for further debridement of the necrosis through the lumen of the LAMS and resulted in complete clinical recovery (Fig. 3a, b). However, 41 days after the first procedure, a last endoscopic debridement that would be followed by an attempt of removal of the stent was, instead, immediately followed by massive bleeding. During the endoscopy, the blood seemed to come from within the WON and not as a result of buried stent syndrome (Fig. 3c, d). The severity of the bleeding made it unmanageable by endoscopic maneuvers and the patient was immediately referred to an angiographic attempt of embolization.



a	b	c	d	e	f
12 mm	24 mm	5 mm	20 mm	5 mm	30 mm

Fig. 2 Plumber ™ biliary stent (M.I.TECH, Seoul, Korea)

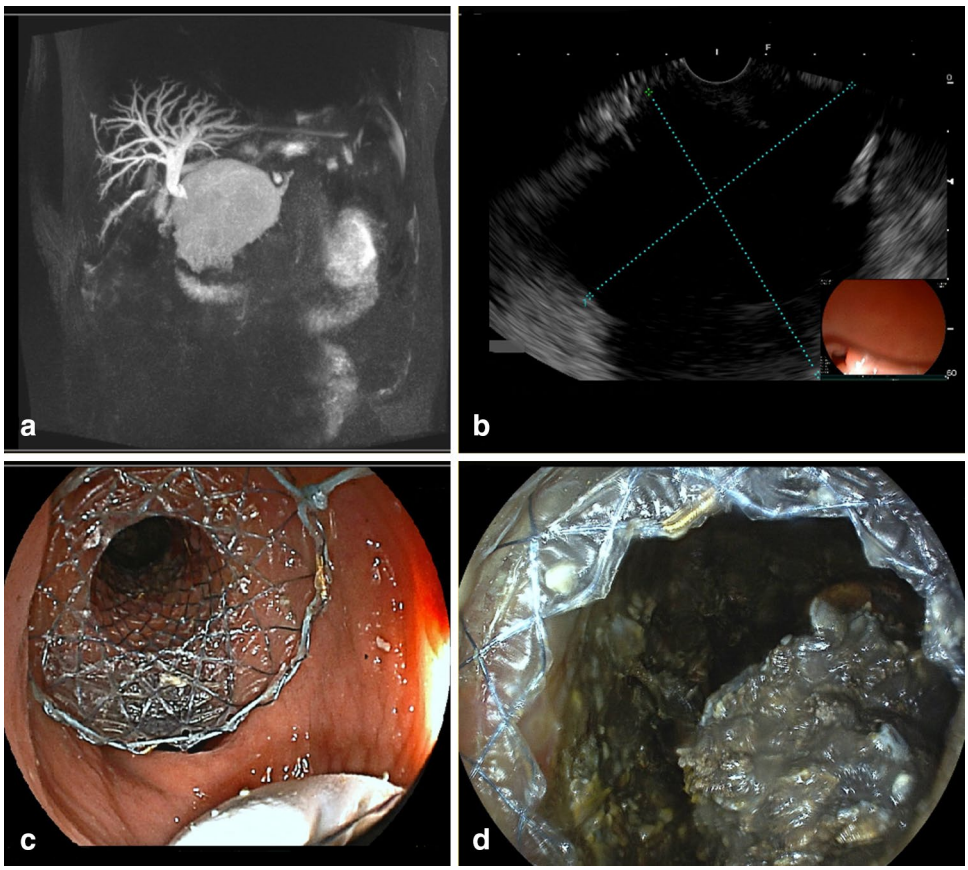


Fig. 1 **a** MRCP disclosing pancreatic cystic lesion and common bile duct dilatation. **b** EUS image of the pancreatic lesion. **c** LAMS placed through the gastric pouch. **d** interior aspect of the pancreatic cystic lesion with debris (*MRCP* magnetic resonance cholangiopancreatography, *EUS* endoscopic ultrasound, *LAMS* lumen apposing metallic stent)

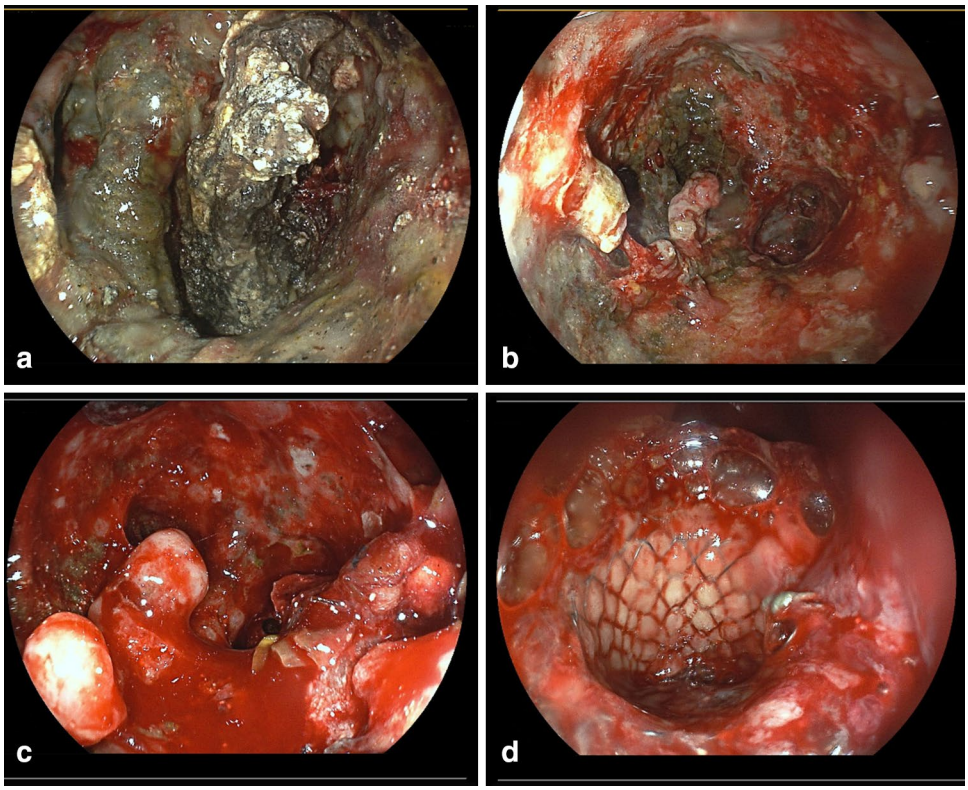


Fig. 3 **a, b** Endoscopic revisions for debridement of the WON performed through the LAMS. **c, d** Last endoscopic revision for debridement disclosing massive bleeding from the WON (*LAMS* lumen apposing metallic stent, *WON* walled-off necrosis)

As the angiography could not identify the vascular pedicle responsible for the bleeding an embolization was not performed and a repeated endoscopy demonstrated that an intense diffuse bleeding coming from within the WON persisted, urgent surgical intervention was proposed.

Surgery began by taking down adherences from the previous bariatric procedure. The gastric pouch was identified and the area of the cystogastric endoscopic bypass accessed. The LAMS was than gently dislodged from the pancreatic WON to identify the source of the bleeding. This maneuver resulted in massive hemorrhage from within the WON. After manual compression of the entire mesenteric root, we were able to identify a profuse venous bleeding coming from within the WON. The pancreatic cystic lesion was located in the inferior border of the pancreatic head (and uncinate process) and dissected into the root of the mesentery. Therefore, the bleeding came from multiple venous branches of the superior mesenteric vein. The massive bleeding was controlled with careful placement of sutures. Nevertheless, the patient died 2 days after in the intensive care unit as a result of these events.

Clinical case 2

A 78-year-old female patient with history of long-term alcohol abuse presented with intense weight loss, abdominal discomfort, anorexia, and post-prandial vomiting. Physical examination revealed a palpable epigastric mass. A magnetic resonance cholangiopancreatography (MRCP) disclosed large pancreatic cystic lesions among the pancreatic head causing extrinsic compression on the duodenum, as long as irregular dilatation of the main pancreatic duct (Fig. 4a, b).

The diagnosis of groove pancreatitis was reached and an EUS-guided fine needle aspiration (FNA) of the cystic lesions was proposed [6]. The EUS-guided FNA was performed using an EchoTip Ultra 19 gauge needle (COOK Medical, Bloomington, IN, USA) (Fig. 4c, d). Five weeks after the procedure, symptoms recurred. The patient was admitted to hospital with intense post-prandial vomiting. Another MRCP was performed, and showed a recurrence of the PFC and intense gastric distension secondary to extrinsic duodenal compression (Fig. 5a, b). The option was then to perform and EUS-guided drainage of the PFC with an LAMS through the stomach. (Fig. 5c, d) A 30 mm Plumber ™ Biliary Stent (M.I.TECH, Seoul, Korea), with 12 mm stent diameter and 24 mm bilateral anchor flanges diameter was used to appose the PFC and the anterior wall of the gastric antrum (Fig. 2). The procedure was performed uneventfully.

However, soon after recovery from sedation, the patient developed acute and intense abdominal pain with clear signs of peritonitis and obliteration of the liver dullness on percussion, suggestive of bowel perforation. The patient was immediately submitted to a diagnostic laparoscopy and the

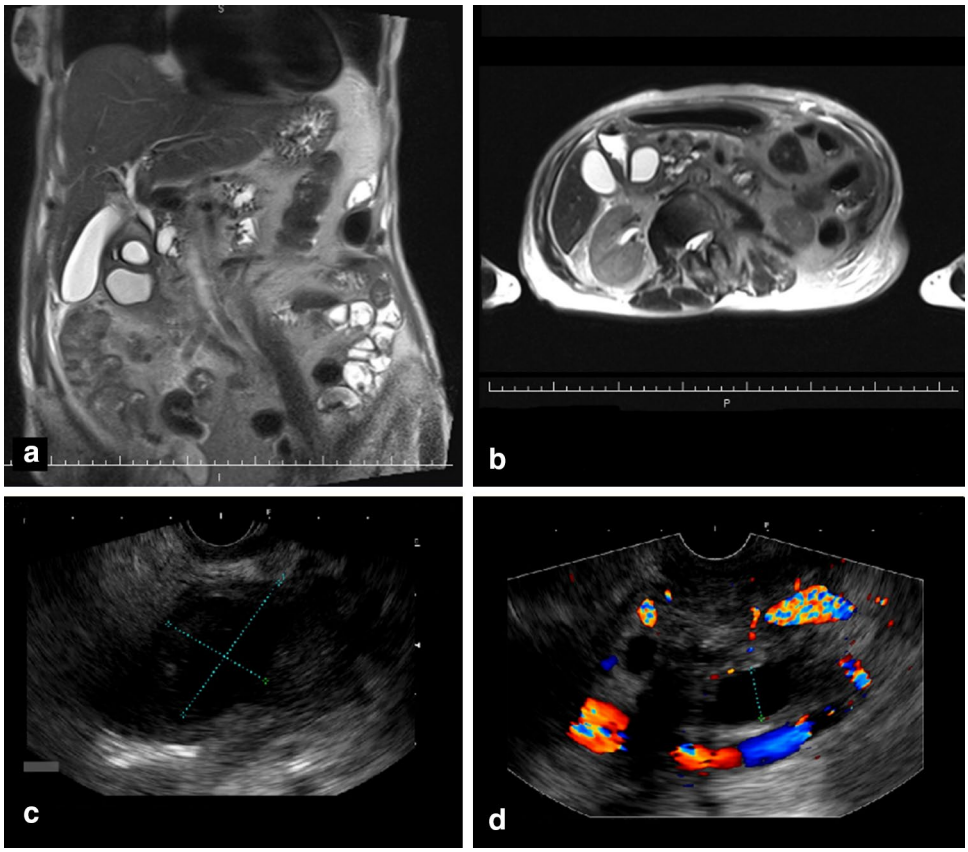


Fig. 4 MRCP disclosing pancreatic cysts in the groove area causing duodenal stenosis (**a** Coronal plane; **b** Axial plane). **c, d** EUS-guided fine needle aspiration of the pancreatic cystic lesion (*MRCP* magnetic resonance cholangiopancreatography, *EUS* endoscopic ultrasound)

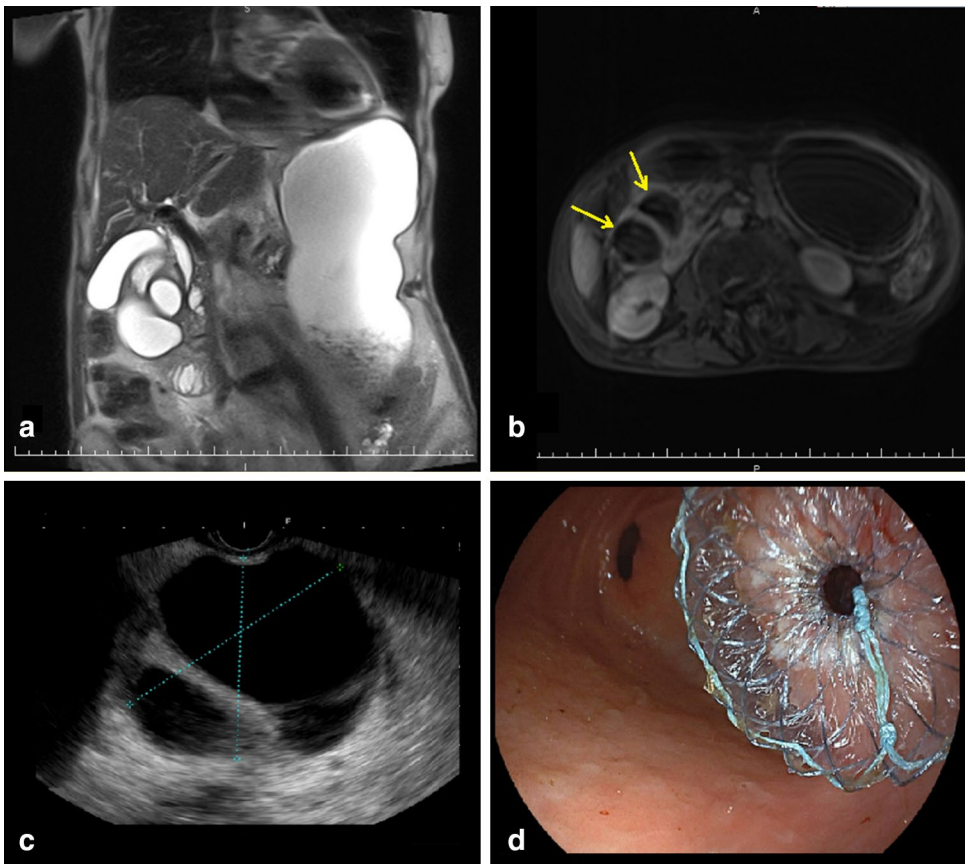


Fig. 5 MRCP disclosing pancreatic cystic lesions, extrinsic duodenal compression, and intense gastric distension: **a** coronal plane; **b** axial plane (yellow arrows: pancreatic cysts). **c** EUS image of the PFC. **d** LAMS drainage of the PFC into stomach (*MRCP* magnetic resonance cholangiopancreatography, *EUS* endoscopic ultrasound, *PFC* pancreatic fluid collection)

intraoperative findings were free peritoneal fluid, a dislodged LAMS still attached to the gastric wall and a pancreatic cystic lesion with a perforation caused by the stent (Fig. 6a, b). The option was to reinsert the stent into the pancreatic cyst and perform a purse-string like suture to better appose the gastric and cystic walls (Fig. 6 c, d).

The postoperative period was uneventful. The patient was progressively returned to oral feeding. Imaging studies performed 1 week after the surgical procedure demonstrated a properly placed stent and no signs of free peritoneal fluids or gas (Fig. 6e, f). The patient was discharged on the eleventh postoperative day.

Discussion

PFCs, usually complications of acute pancreatitis, were first classified into an international consensus meeting held in Atlanta in 1993 that resulted in the Atlanta Criteria [7]. As a result of better understanding the physiopathology of these lesions, more advanced diagnostic tools and new therapeutic approaches emerged. Those criteria were reviewed in the same city in 2012, resulting in the revised Atlanta Criteria [8]. According to the revised criteria, a PFC must be drained if the patient presents with symptoms or complications, such as gastrointestinal obstruction, bile duct obstruction, abdominal pain, vascular compression, or infection [8]. The same indications of intervention are applied to pancreatic walled-off necrosis (WON) that will result from necrotizing pancreatitis that do not resolve spontaneously [8].

While surgical and percutaneous approaches have been the standard techniques to treat PFC and WON for the past decades, the endoscopic approach has emerged as a less invasive option for these complications of acute pancreatitis. Recent literature has associated the endoscopic drainage of PFC and WON as an effective procedure with shorter hospital stays, lower costs, lower morbidity and mortality, and faster recovery to normal activities when compared to the other approaches [9–11].

Nowadays, the usual endoscopic approach for PFC involves the use of sonographic guidance to locate the lesion and identify an avascular path to the cystic lesion [9]. The

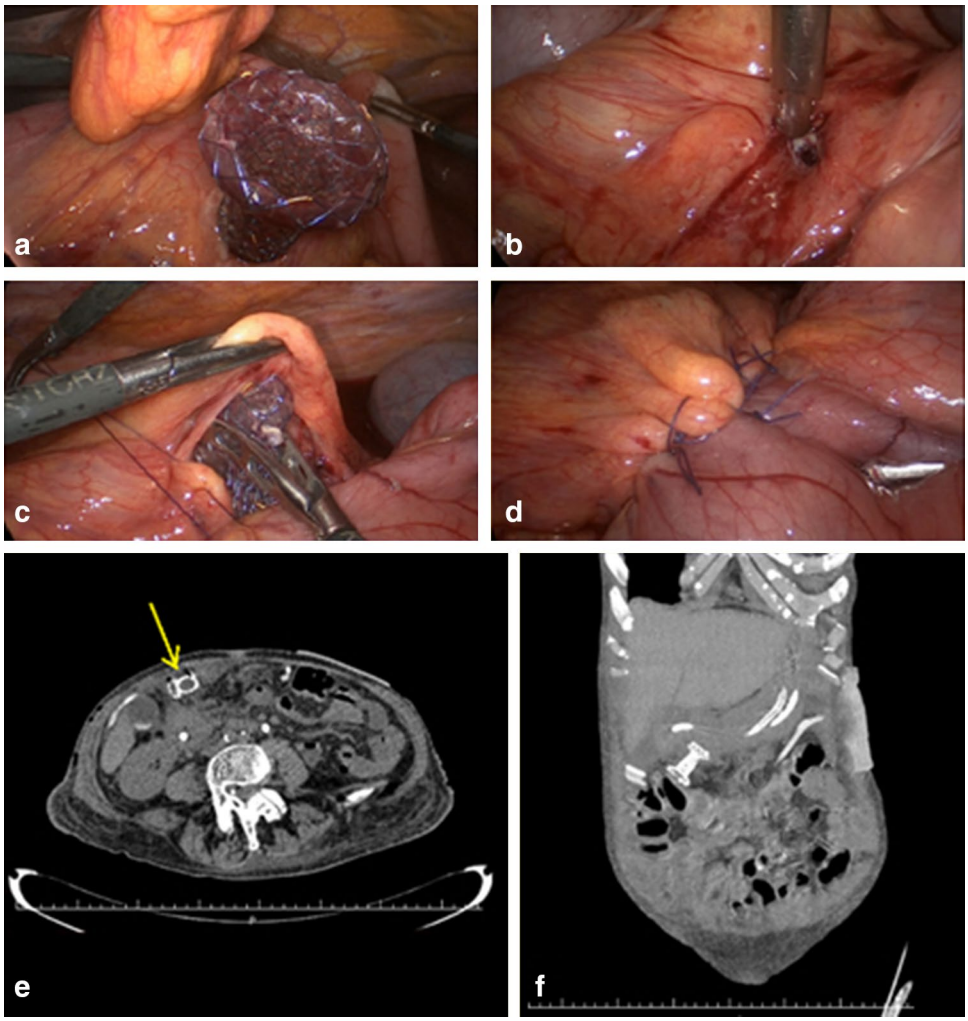


Fig. 6 Intraoperative findings. **a** Dislodged LAMS attached to the gastric wall. **b** Pancreatic cyst wall with perforation. **c** Reinsertion of the stent into the pancreatic cyst. **d** Final aspect of the suture between gastric and cystic walls. Postoperative computed tomography: **e** Axial plane showing the stent (yellow arrow); **f** Coronal plane (*LAMS* lumen apposing metallic stent)

use of plastic stents for drainage has been substituted by the more efficient LAMS in 2012 as they offer larger lumen, necessity of fewer endoscopic revisions, allow endoscopic necrosectomy (that is particularly useful for WON) and are designed with flanged ends to better anchor them in a determined place (thus reducing the risk of migration) [12, 13]. For these reasons, LAMS are the preferred material to perform cystogastrostomies and WON necrosectomies [5].

Nevertheless, EUS drainage of PFC and WON with LAMS is not free of complications. The complication rate is usually reported in the literature as fewer than 10% and the most common described are stent migration, perforation, buried stent syndrome, bleeding, and occlusion [12, 14, 15].

We have performed 108 EUS-guided PFC drainages. Usually, we use the Plumber ™ Biliary Stent (M.I.TECH, Seoul, Korea) (Fig. 2). The routine of our center is to perform weekly endoscopic revisions and further debridement of WON necrosis if necessary. Most of the times, within 4–5 weeks, the LAMS is removed. From those 108 procedures, we had 8 complications (4 bleedings, 2 infections, 1 stent migration, and 1 perforation), what results in a complication rate of 7.4% that is consistent with the literature [12, 14, 15]. From these 8 complications, only two patient required urgent surgical procedures and one died as a consequence of the treatment.

By carefully reviewing these two cases, we aimed to identify the underlying factors that resulted in such adverse outcomes.

The male patient that presented with massive and fatal bleeding after endoscopic debridement had a WON secondary to acute alcoholic pancreatitis. During the urgent surgical exploration, we could identify that the source of the massive hemorrhage was large vessels from the small bowel mesentery that were probably submitted to friction by the LAMS or eroded by the cystic pancreatic lesion, a known possible complication of PFC and WON [16, 17]. One important fact came to our attention when reviewing the case: the size and anatomical location of the cystic pancreatic lesion.

To be amenable to endoscopic treatment, especially in patients previously submitted to roux-en-y gastric bypass, the cyst must be in contact with the gastric (or gastric pouch) posterior wall, meaning that it must grow anteriorly. Nevertheless, in this particular case and due to its large dimensions (up to 10.7 cm), the lesion also extended in the dorsal direction. Indeed, MRCP images demonstrate that several large vessels from the mesenteric root were in close contact with the WON and were probably responsible for the massive hemorrhage.

Another key point would be the period of time that the LAMS should remain inside the PFC. In this particular case, the LAMS had been in place for almost 6 weeks when the bleeding occurred during the intended last revision that would be followed by the stent removal. In our opinion, an LAMS should be removed within 3 weeks after its initial insertion, thus reducing the risk of the stent eroding any surrounding blood vessels.

In a recent publication by Bang et al., the authors found that all adverse events related to LAMS insertion occurred 3 or more weeks after stent placement (including bleeding, biliary obstruction, and buried stent syndrome) [18]. As we do, they believe that, as a PFC resolves, the LAMS beings to exert friction against vessels surrounding the necrotic cavity, thus precipitating bleeding. One reasonable strategy, as they propose, is to perform a computed tomography 3 weeks after the LAMS placement and, if the PFC has resolved, proceed to stent removal [18].

In such difficult cases, in which the pancreatic lesion extends into the mesenteric vessels, even surgical treatment would probably enhance the risk of bleeding to the digestive tube. We think that these cases would probably benefit of the initial treatment with tomography-guided catheter drainage.

The female patient presented with PFC secondary to long-term alcohol abuse. In her case, the PFC did not grow in the direction of the mesentery. However, they arose from a groove pancreatitis and were located in the neck and head of the pancreas in close contact with the descendant part of the duodenum. In these cases, one should keep in mind two paramount factors: the thickness of the cystic wall and its anatomical relation with the gastric wall.

It is a major concern that the cystic wall is thick enough not to rupture due to the traction of a stent placement. Therefore, the drainage must be performed after the collection gets walled-off or encapsulated, usually at least 4 weeks after the initial presentation [19]. Moreover, the distance from the PFC or WON to the gastric wall should not exceed 1.5 cm to diminish the risk of stent dislodgement or migration as a result of traction [20].

In this case, the PFC were in close contact with the duodenal arch and we think that lesions on this part of the pancreas (not in such close contact to the gastric wall as lesion on the pancreatic body/tail) exert downward traction of the stomach that may result in dislodgement of the stent.

Conclusion

Drainage of pancreatic fluid collections by lumen apposing metallic stents placed under endoscopic ultrasound guidance is a safe, minimally invasive and effective procedure. Nevertheless, severe complications as massive bleeding and stent dislodgement may occur. In our series of 108 cases, the incidence of bleeding and stent dislodgement with perforation was 3.7% and 0.9%, respectively. To prevent these potentially fatal complications, one must pay close attention and make sure that the pancreatic cystic lesion is not eroding

into the mesentery and if it is, indeed, in close contact with the gastric wall to avoid excessive traction and dislodgement of the stent.

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