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Review Article

Self-expandable metal stents for endoscopic ultrasound-guided drainage of peripancreatic fluid collections

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A B S T R A C T

Endoscopic ultrasound (EUS)-guided transmural drainage has evolved as an important treatment modality for peripancreatic fluid collections (PFCs). Recently, self-expandable metal stents (SEMS) have been introduced as an alternative for the traditionally used double-pigtail plastic stents, for endoscopic drainage. Due to the larger diameter (>10 mm) of SEMS, a wide drainage opening can be created, with a potentially reduced risk of stent occlusion and associated complications, and a direct access route if endoscopic necrosectomy is indicated. The use of different types of SEMS has been reported in several case reports and small case series. Although the results of these studies seem promising, the available results to date are limited and need critical appraisal. Large prospective and randomized trials are needed to evaluate the efficacy and safety of the placement of SEMS for endoscopic drainage of PFCs.

Keywords: Pancreatic necrosis, Pancreatic pseudocyst, Peripancreatic fluid collection, Self-expandable metal stents, Transmural drainage

Introduction

Peripancreatic fluid collections (PFCs) may complicate the course of acute and chronic pancreatitis, pancreatic surgery or trauma. They develop due to disruption of the pancreatic duct, with subsequent fluid leakage, or as a consequence of maturation of (peri)pancreatic necrosis.[1–3] Over the past decade, endoscopic ultrasound (EUS)-guided transmural drainage has evolved as an important treatment modality for PFCs.[4]

The aim of this review is to give an overview of EUS-guided treatment modalities for the different types of PFCs, with special focus on the use of self-expandable metal stents (SEMS).

Definitions of peripancreatic fluid collections

The use of precise terminology and strict definitions for different types of PFCs is important, since each form requires a distinct treatment strategy. Moreover, a universal classification system is essential for comparing results of studies. In 1992, the widely accepted Atlanta Classification was introduced as a clinically based classification system for PFCs that occur as a complication of acute pancreatitis.[1] Definitions were proposed for the following types of collections: acute fluid collection, pseudocyst, pancreatic abscess and pancreatic necrosis. In order to describe the evolution of pancreatic necrosis and acute fluid collections to a more organized, partially encapsulated state, Baron et al subsequently introduced the term, organized pancreatic necrosis, in 1996.[2] Although this term for describing PFCs was not defined in the 1992 Atlanta Classification, it has been widely adopted from then on.[5]

The original Atlanta Classification is considered to be a milestone in the classification of PFCs. Nonetheless, new insights into the pathophysiology of acute pancreatitis, improved imaging techniques, and the emergence of minimally invasive techniques for the management of PFCs, made it necessary to revise the Atlanta Classification in 2008 (Table 1).[6,7] In the revised Atlanta Classification, PFCs were defined by the presence or absence of necrosis. This distinction between fluid and nonliquefied collections is important, as the therapeutic strategy and clinical outcome differ between collections containing fluid alone and those containing necrotic debris as well. Subsequently, collections were further subdivided according to whether the contents are infected or sterile.[8–11]

Acute collections, developing within the first 4 weeks after the onset of acute pancreatitis, are referred to as either acute peripancreatic fluid collections (APFC) or as acute necrotic collections (ANC). APFCs are extrapancreatic homogeneous collections without nonliquefied components, i.e., debris or necrosis, and lack a well-defined wall. The majority of these APFCs are reabsorbed spontaneously within several weeks and only a minority matures into a pancreatic pseudocyst (PP). Drainage is only indicated in the rare

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Table 1 Comparison of Atlanta Classification 1992 and Revised Atlanta Classification 2008

Atlanta Classification – 1992	Working Group Classification – 2008
<4 wk after onset of acute pancreatitis	
Acute fluid collection	Acute peripancreatic fluid collections (APFC)
	Sterile
	Infected
Pancreatic necrosis	Acute necrotic collection (ANC)
	Sterile
	Infected
≥4 wk after onset of acute pancreatitis	
	Pancreatic pseudocyst (PP)
Pancreatic pseudocyst	Sterile
Pancreatic abscess	Infected
Organized pancreatic necrosis*	Walled-off pancreatic necrosis (WOPN)
	Sterile
	Infected

* Introduced by Baron et al. (1996).

case that an APFC becomes infected.[7,12] In contrast, ANCs contain both fluid and necrotic material in various proportions, due to gradual liquefaction of necrotic tissue. These collections are not encapsulated and infected necrosis in these collections is an indication for drainage.[7,11]

Within a period of approximately 4 weeks, acute collections mature and become encapsulated. These mature collections are subdivided into a PP and walled-off pancreatic necrosis (WOPN). PPs are defined as homogeneous fluid collections surrounded by a well-defined nonepithelialized fibrous wall, without nonliquefied components. They usually contain increased amylase and lipase levels, due to communication with the pancreatic ductal system. Sealing of such ductal disruptions explains the spontaneous resolution of the majority of PPs. Intervention is only indicated for PPs causing pain, jaundice or gastric outlet obstruction, due to compression on the biliary or gastrointestinal tract or fever due to infection.[13–15]

WOPN represents the late stage of an AFPC, previously referred to as organized pancreatic necrosis.[2] A thickened wall, without an epithelial lining, forms the interface between necrosis and adjacent viable tissue. Infected WOPN usually require drainage to effectively control sepsis, whereas in patients with sterile WOPN, the need for drainage is based on the same symptoms as for a PP.[7,12,13]

Treatment modalities

The management of PFCs has changed considerably over the last decades. Until the introduction of endoscopic drainage of PFCs in the late 1980s, treatment options were limited to surgical and percutaneous drainage. Since then, endoscopic transmural drainage has emerged as an important minimally invasive treatment modality.[4,16,17]

Surgical drainage

Surgery of PP involves internal drainage by creating an anastomosis between the cyst and a small-bowel loop, a cyst-enteric anastomosis. Although success rates are excellent, the procedure is associated with significant morbidity and mortality rates of 24% and 5.8%, respectively.[18,19] Furthermore, surgical drainage of PP is associated with a longer hospital stay compared to EUS-guided drainage.[20] The main role of surgical drainage for PP is, therefore, adjunctive to an endoscopic procedure or as salvage therapy.[4]

The traditional surgical approach for WOPN is an open surgical necrosectomy. This invasive procedure is associated with high morbidity (34–95%) and mortality (11–39%) rates.[21] Minimally invasive surgical techniques, including laparoscopic necrosectomy and video-assisted retroperitoneal debridement (VARD), have gained wide popularity as alternatives due to lower morbidity and mortality rates (25–88% and 0–25%, respectively).[21,22] A recent randomized pilot study, comparing surgical necrosectomy to endoscopic necrosectomy, showed a higher pro-inflammatory response as well as higher morbidity and mortality rates for the surgical approach in cases of infected necrosis.[23] Despite these results, to date, surgical necrosectomy still has an important role in the step-up treatment algorithm for WOPN.[21,24]

Percutaneous drainage

A less invasive alternative to surgery is percutaneous drainage, performed under radiological guidance. Although clear fluids can be drained effectively via the percutaneous drain, a drawback of this technique is the inability to clear the necrotic content from the cyst.[4] In approximately half of patients with infected WOPN, drainage of the infected fluid provides adequate control of sepsis and the necrotic material will be reabsorbed without formal necrosectomy. However, additional necrosectomy is needed in the other patients.[21,24–27] Risks associated with percutaneous drainage include puncture of adjacent viscera, secondary infection and bleeding. Furthermore, a prolonged need for an external draining catheter may result in a considerable risk of developing a pancreaticocutaneous fistula. For collections which cannot be accessed endoscopically, or those without a mature wall, percutaneous drainage may be of additive value.[4,26]

Endoscopic drainage

As mentioned above, endoscopic transmural drainage of PPs was introduced in the 1980s.[16,17] The first endoscopic necrosectomy for WOPN followed in 1996, by Baron et al.[2] Since the first reports, much more experience has been gained and endoscopic techniques have evolved. Endoscopic drainage entails the creation of a fistulous tract between the PFC and the lumen of the upper gastrointestinal tract, followed by placement of double-pigtail stents and eventually a nasocystic catheter to facilitate drainage. To be eligible for this approach, PFCs should have a well-defined wall and be located within 1 cm of the duodenal, esophageal or gastric wall. Furthermore, the presence of a luminal bulge is a prerequisite when performing endoscopic drainage without EUS-guidance, since this is a relatively blind approach. Due to direct sonographic visualization, the introduction of EUS-guidance enables drainage of nonbulging PFCs, without an increased risk of perforation or puncture of other organs. Moreover, intervening vessels can be identified by using Doppler ultrasound and avoided at the puncture site, with a potential reduction of the bleeding risk.[4,28] Apart from access and safety, performing EUS before endoscopic drainage can provide essential information to rule out alternative diagnoses and differentiate between WOPN and PPs.[29,30]

Two randomized trials have compared endoscopy-guided, with EUS-guided, drainage for PPs. In the EUS-guided group, fewer complications were reported; however, this difference was not statistically significant. The technical success rates were significantly higher for EUS-guided drainage (94–100%) than for endoscopy-guided drainage (33–72%) ($P < 0.05$). This difference was mainly due to a high failure rate for nonbulging PP in the endoscopy group.[31,32] Although some other studies have reported technical success rates to be equal for both endoscopy-guided and EUS-guided drainage, EUS-guidance is increasingly being used for drainage.[28,33]

The success rate of EUS-guided drainage is highly dependent on the type of PFC drained. The use of different nomenclature, leads to