The role of endoscopic intervention in the management of inflammatory pancreatic fluid collections

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Pancreatic fluid collections (PFCs) are a frequent complication of pancreatitis, or less commonly, pancreatic trauma or surgery. The revised Atlanta Classification categorizes PFCs as acute or chronic, with further subclassification of acute collections into acute peripancreatic collections and acute necrotic collections and of chronic fluid collections into pseudocysts and walled-off pancreatic necrosis. Acute PFCs are generally only subjected to an intervention when they are infected and not responding to antibiotics and are not managed endoscopically. Chronic PFCs, both pseudocysts and walled-off pancreatic necrosis, require intervention only when symptomatic or enlarging over time. Endoscopic ultrasound-guided drainage has become the mainstay of management for chronic PFCs that require intervention. Developments in medical devices over the past few years have significantly simplified and shortened the duration of the procedure itself, but the optimum choice of stent in different clinical scenarios remains to be defined, as does the place of endoscopic necrosectomy. To optimize outcomes, these patients should undergo a careful preprocedure workup and discussion in a multidisciplinary environment and procedures should be carried out in high-volume pancreatic units. Eur J Gastroenterol Hepatol 00:000–000

Introduction

Inflammatory pancreatic fluid collections (PFCs) can develop following an episode of acute pancreatitis, in patients with chronic pancreatitis, following pancreatic surgery or abdominal trauma, and are secondary to fluid extravasation or liquefaction of pancreatic necrosis [1,2]. These fluid collections contain amylase-rich fluid. Our understanding of the natural history and evolution of PFCs has evolved considerably over the past two decades with the development of high-resolution, cross-sectional imaging and endoscopic ultrasound (EUS) [3]. Over the same time frame, techniques to deal with symptomatic persistent peripancreatic collections have moved from open surgery, through minimally invasive surgery and to now primarily endoscopic strategies. Increasingly more, the interventional gastroenterologist is replacing the pancreas surgeon at the primary attending physician.

Our understanding and experience of when and how to intervene in these PFCs has also grown, with a resultant improvement in patients' outcomes. The revised Atlanta Classification [4] (Fig. 1) provides a recent practical and clinically useful system. The Atlanta consensus categorized inflammatory PFCs into four categories on the basis of the presence of necrosis within the collection, the development of a well-defined wall and the time frame from the index episode of acute pancreatitis. The four categories are as follows: acute peripancreatic fluid collection (acute peri-PFC), acute necrotic collection (ANC), pseudocyst and walled-off necrosis (WON). An acute peri-PFC is a fluid collection with no necrosis and no well-defined wall, which develops within 4 weeks of an episode of interstitial oedematous pancreatitis. These collections are adjacent to the pancreas and conform to the normal fascial planes. The majority of acute peri-PFCs resolve with time, but a small proportion can mature into a pseudocyst. A pseudocyst is a well-circumscribed, encapsulated collection of fluid with a well-defined, nonepithelialized inflammatory wall, which contains minimal to no necrosis. It takes at least 4 weeks for an acute peri-PFC to mature into a pseudocyst, but can take longer. Approximately 20% of cases of acute pancreatitis develop pancreatic necrosis,

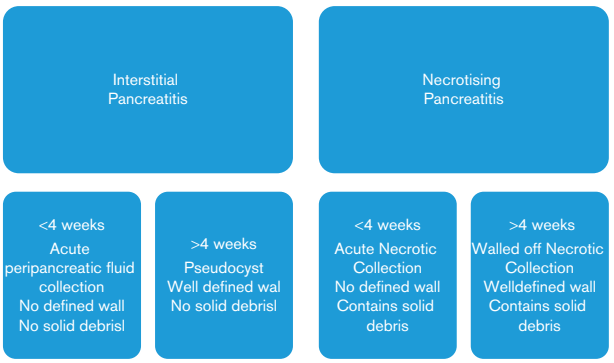

Fig. 1. Revised Atlanta Classification.

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which may lead to the development of ANCs within the first 4 weeks of the acute insult. ANCs, similar to acute peri-PFCs, are poorly defined collections with no wall, but are distinguished from acute peri-PFCs by the fact that they contain mixed liquid and solid components, and can be intra-pancreatic as well as involving the extrapancreatic spaces. Moreover, ANCs only develop in the setting of acute necrotic pancreatitis.

WON is a mature, encapsulated collection that develops more than 4 weeks after the onset of acute necrotizing pancreatitis. WON contains both liquid and solid or semisolid necrotic material; there can be multiple collections and they can be located within, adjacent to and distant from the pancreas.

Differentiation between types of PFC can be challenging and relies on high-quality imaging and an understanding of the pathophysiology and natural history of the disease [5]. The most common initial imaging modality for the diagnosis of PFCs is a contrast-enhanced computed tomography (CT) scan of the abdomen, which is widely available, relatively inexpensive and can determine the extent of necrosis. However, in comparison with CT, MRI (Fig. 2) may have superior sensitivity and specificity for the detection of PFCs and has been shown to be more accurate for the delineation of pancreatic ductal (PD) integrity and for the characterization of collection contents [6–9].

The vast majority of acute PFCs resolve spontaneously and do not require any intervention [10]. Indeed, van Sandvoort and colleagues showed that less intervention, and where possible a delay from time of admission to intervention, improved outcome. A study of 242 patients found that mortality was reduced as the time from hospital admission to intervention of the PFC was increased (0–14 days: 56%; 14–29 days: 26%; and > 29 days: 15%; $P < 0.001$) [11].

Approximately 30% of ANCs become infected (acute infected necrosis) and require treatment with antibiotics and percutaneous drainage usually 2–4 weeks after the initial insult [12]. Indeed, the only indication for drainage of an acute PFC is drainage of a probable or definite infected ANC. It can be difficult to distinguish between acute infected necrosis and sterile necrosis because of the severe systemic inflammatory response syndrome that usually develops in patients with necrotizing pancreatitis [13]. Given the fact that acute collections do not have a defined wall and that an endoscopic drainage procedure is inherently a nonsterile procedure (because of contamination from gastric and oral flora), endoscopic drainage procedures are not suitable in this context. A sterile, percutaneous, radiological drainage procedure is the intervention of choice and the fluid obtained can be sent concomitantly for culture and sensitivity.

The management of acute infected necrosis in the setting of acute severe pancreatitis is beyond the scope of this review and we refer readers to a comprehensive review of this topic [12]. This review focuses on patients with mature pancreatic collections, either WON or pseudocysts, and on identifying those patients who benefit from drainage together with a discussion of endoscopic techniques to achieve robust pseudocyst-enteric drainage.

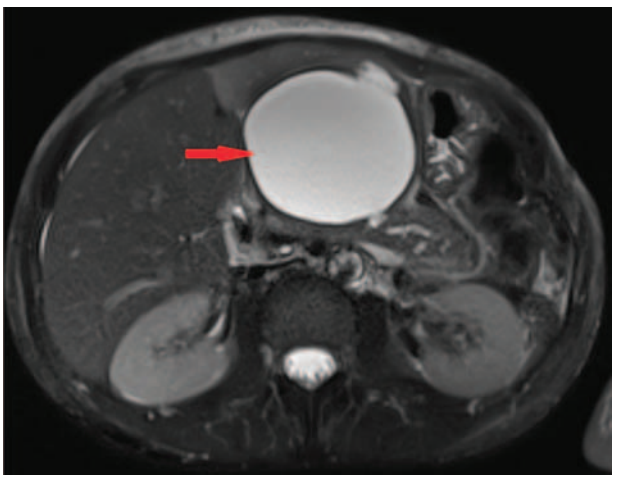

Fig. 2. Axial T2-weighted MRI image of a pseudocyst. The red block arrow points to a 7 × 8 cm fluid-containing pseudocyst adjacent to the body of the pancreas.

Mature pancreatic fluid collections: indications for drainage

The current evidence base supports drainage of mature PFCs (either pseudocysts or WON that are more than 4 weeks in duration with a defined wall) only when they are symptomatic, infected, or where longitudinal follow-up indicates that they are enlarging [10]. Size alone is not an indication for drainage, although pseudocysts larger than 6 cm tend to be symptomatic [14,15]. PFCs cause symptoms through compression of an adjacent hollow viscus (the stomach or the duodenum) and can cause early satiety, gastric outlet obstruction, nausea and abdominal pain. They can also cause jaundice by obstruction of the biliary tree. Drainage of infected necrosis is often required for effective control of sepsis [16,17]. In patients who have underlying chronic pancreatitis, it can be difficult to distinguish whether pain is because of a PFC or the underlying chronic pancreatitis, and this might only become clear following a drainage procedure.

Mature pancreatic fluid collections: choice of intervention technique

Once a decision has been made to drain a pseudocyst or WON, a number of methods can be used, including surgical drainage (either laparoscopic or open), a percutaneous radiological approach or through transluminal endoscopic drainage. The chosen technique will often depend on available local expertise.

Since the first surgical internal drainage procedures described by Jedlicka [18] in the early 1920s, the promise of robustly returning amylase-rich juice to the enteral stream has been very attractive. Anastomosing a none-pithelial lined structure with an epithelial lined structure has an inherent tendency towards anastomotic stricturing in short-term follow-up. However, the rate of stricturing does not seem to be clinically relevant as reported recurrence rates when pseudocysts are surgically anastomosed to the stomach (pseudocyst-gastrostomies), duodenum (pseudocyst-duodenostomy) and jejunum (pseudocyst-jejunostomy) are relatively low, ranging from 0 to 30% on the basis of earlier series [19].

The endoscopic approach is most commonly performed under EUS guidance and this approach increases technical

success by including nonbulging PFCs and those located in the tail of the pancreas [20]. In the past, and in some centres to this day, when the PFC causes a visible bulge into the stomach or the duodenum, a so-called conventional transmural drainage method has been used and has been shown to be safe and effective in the presence of a visible endoscopic bulge and where portal hypertension has been excluded. A prospective comparative study in 99 patients, among whom those with bulging pseudocysts underwent conventional transmural drainage and those without bulging pseudocysts underwent endoscopic ultrasound-guided drainage (EUSGD), showed similar success and adverse event rates [21].

Nowadays, endoscopic management with EUSGD, either a cystogastrostomy or a cystoduodenostomy, has become the standard of care in most centres specializing in the management of pancreatitis and associated PFCs. EUSGD has a number of potential advantages over surgical cystogastrostomy (SCG), particularly in the management of pseudocysts. It is less invasive than surgery, can be performed under conscious sedation and can also be performed as a day-case. Small studies and a recent systematic review have compared outcomes in EUSGD and SCG. EUSGD is associated with similar technical success and complication rates to SCG, but with a shorter hospital stay, lower overall cost and better mental health and physical health component scores among patients [22–24]. Percutaneous drainage is also an option, but can result in the development of a pancreaticocutaneous fistula, a complication not encountered with EUSGD [25].

Endoscopic ultrasound-guided pancreatic fluid collection drainage: general preprocedure considerations

Before EUSGD is performed, the clinical history, cross-sectional imaging and laboratory test results should be reviewed. The international normalized ratio and platelet counts should be corrected if abnormal to less than 1.5 and at least 50 000/mm^3, respectively [26]. The management of anticoagulants and antiplatelets is similar to other high-risk endoscopic procedures such as polypectomy and endoscopic sphincterotomy [27]. Most experts recommend the use of broad-spectrum antibiotics to reduce the risk of pseudocyst infection once a decision is made to proceed with drainage and current practice is to use a single dose of ceftriaxone 2 g administered intravenously before the procedure. This is done to cover a potential periprocedural bacteraemia. In cases where there is a significant concern of on-going pancreatic sepsis, antimicrobials with proven PFC penetration such as carbapenems may be utilized [28]. There is some evidence, although not substantiated in large studies, to suggest that concomitant proton pump inhibitor use may increase the risk of superinfection of the PFC following EUSGD; the associated hypochlorhydria increases gastric bacterial levels, which in turn can lead to contamination of the PFC contents [29]. It is our practice therefore to discontinue proton pump inhibitor medications at least 2 days before elective EUSGD.

It is important to determine the integrity of the main PD before performing a drainage procedure. Disruption of the main PD, or the disconnected duct syndrome, has been shown to result from a more severe episode of pancreatitis. A retrospective review of 105 patients with acute pancreatitis found that nearly half of patients with severe pancreatitis had concurrent PD disruption, whereas a normal PD was noted in 100% of patients with mild pancreatitis [30]. A further study reported that 70% of PD leaks resolve over time [31]. However, disruption of PD anatomy is associated with a decreased rate of pseudocyst resolution. In 563 patients with pseudocysts, it was found that spontaneous resolution occurred only in 0–5% of patients with a ductal disruption compared with 87% of patients with a normal PD [32]. Moreover, resolution of both pseudocysts and WON in patients with a ductal disruption who underwent EUSGD with previous transpapillary PD stenting by endoscopic retrograde pancreatography (ERP) was 97.5% compared with 80% in those who underwent with PFC drainage by EUSGD alone [33]. As a result, that group suggested that a combined approach could be followed, with ERP to assess PD integrity and placement of a bridging stent if a disruption is identified, and subsequent endoscopic transmural stent insertion [34]. Another study, however, showed that in cases of complete PD disruption, transpapillary PD drainage by ERP in combination with EUSGD had no additional benefit over EUSGD or percutaneous drainage alone [34]. Hence, when a disconnected duct has been identified, the need for transpapillary drainage before EUSGD has not been established conclusively to date.

Endoscopic ultrasound-guided drainage: techniques, devices and efficacy

EUSGD involves puncturing a hole through the gastric (cystogastrostomy) or, less commonly, the duodenal (cystenterostomy) wall into the adjacent PFC, with subsequent insertion of stents across the gut wall into the PFC cavity. A complete pancreatic EUS examination should be performed first to confirm the appropriateness of the indication, assess the PFC contents and wall thickness, and exclude any contraindications such as a varices or pseudoaneurysms. Varices are not an absolute contraindication, once they are avoided at the puncture site. Pseudoaneurysms can be treated with embolization and the mature PFC can then be managed by EUSGD. The initial puncture can be 'cold' using a standard FNA needle (using no cautery) or 'hot' using a variety of cautery devices, such as a needle knife, a Cystotome (Cook Medical) or more recently the Hot AXIOS system (Boston Scientific). Where a cold puncture method is used, the resulting narrow fistula across the gut wall is then dilated using a biliary dilatation balloon to facilitate passage of one or more wires and stents across the gut wall into the cyst. The use of cautery may increase the risk of perforation or damage to a surrounding structure, but has the advantage of improving access to the PFC by creating a wider puncture site and may also reduce periprocedure bleeding [35]. AQ4

A number of stent types are now available for insertion at EUSGD. Traditionally, one or preferably two double-pigtail stents were inserted into the cyst. However, the double-pigtail stent method can be time consuming and generally results in the placement of one to two (sometimes more) narrow bore stents into the PFC. These narrow stents are prone to blockage, although drainage is not entirely dependent on the patency of the stents themselves,

but also occurs directly around the stents from the fistula opening itself. Double-pigtail stents are, however, relatively inexpensive.

More recently, a number of metal stents have become available. These include fully covered self-expanding metal stents (FCSEMS) and lumen apposing stents (LAMS). FCSEMS, such as the NAGI (Taewoong Medical) stents, are tapered wide-bore SEMS that are technically easier than double-pigtail stents to insert, but are more expensive, and there is a risk of hyperplastic overgrowth, stent migration and local damage to tissues [36]. LAMS, such as the AXIOS (Boston Scientific) or Spaxus (Taewoong Medical) stents, have biflanged (dumbbell) shapes allowing for tissue apposition and, in theory, a reduced risk of migration. The Hot AXIOS system (Boston Scientific) has an integrated puncture and stent deployment system that can be used 'free-hand' without the need for a guidewire (Fig. 3). The wider diameter (10–16 mm) of both FCSEMS and LAMS, compared with double-pigtail stents, may allow for better drainage of the PFC and also provides a conduit for endoscopic necrosectomy that can be performed at the index procedure or at a later stage.

Although LAMS are increasingly being used for drainage of PFCs, their advantage over plastic stents has not been established consistently to date and there are conflicting results. LAMS may be safer as they may minimize the risk of perforation and peritoneal leakage of PFC contents [37]. Higher rates of stent occlusion and perforation have been reported with double-pigtail stent insertion, whereas the rate of stent migration is higher with FCSEMS without antimigration flaps [35]. Rates of bleeding seem to be similar with both stent types [38–40]. LAMS with an electrocautery enhanced delivery system (Hot AXIOS) have yielded better outcomes with fewer adverse effects [41]. Technical success was defined as the ability to access and drain pseudocyst by placement of a transmural stent, whereas treatment/clinical success was defined as resolution of the collection and associated symptoms (Table 1). We recently reported a multicentre experience of 57 consecutive cases treated with the Hot AXIOS stent system and found high technical and treatment success rates with low rates of complication [42]. Sharaiha and colleagues reported on 230 patients and found complete pseudocyst resolution in 89% with pigtail stents compared with 98% using FCSEMS. Moreover, after drainage of pseudocysts, adverse events occurred 2.5 times more commonly with plastic pigtail stents than with FCSEMS [43]. In contrast to that study, a recent meta-analysis that included 698 patients found no difference in treatment success, adverse events or recurrence rates

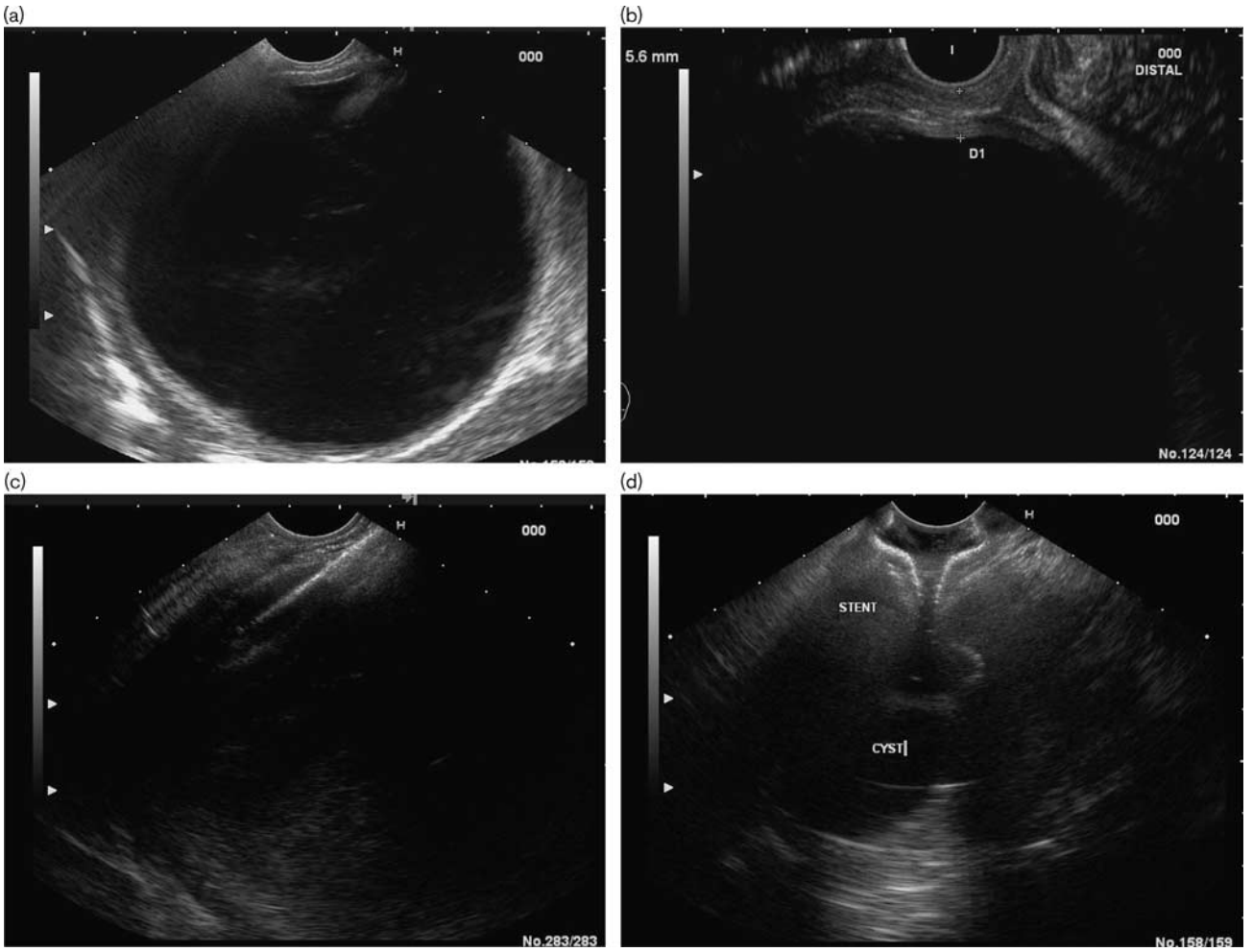

Fig. 3. Hot AXIOS LAMS insertion. (a) 7 cm pseudocyst. (b) 5.6 mm wall between the stomach and the cyst. (c) Hot AXIOS stent in a cyst with visible deployment of the internal flange. (d) Dumbbell shaped Hot AXIOS stent *in situ*. LAMS, lumen apposing metal stent.

Table 1. Technical and clinical success rates with different types of stents

	Technical success	Clinical success
DPS	92% pseudocyst	88–98% pseudocyst 63–70% WON
LAMS	89–100%	93–100%

DPS, double-pigtail stent; LAMS, lumen apposing metal stent; WON, walled-off necrosis.

between pseudocysts drained with multiple plastic stents versus metal stents [44,45]. In another recent retrospective study, Bang and colleagues showed that there was no difference in the clinical outcomes using either LAMS or double-pigtail stents for the drainage of both pseudocysts and WON. However, LAMS had a significantly shorter median procedure time (8.5 vs. 25 min, $P < 0.001$). They also reported that treatment of pseudocysts with double-pigtail stents was less expensive than LAMS, but that there was no price difference when treating WON [46]. As a result, they suggested using LAMS for a select group of sicker patients who may not tolerate a longer procedure and for patients with WON. In contrast to those studies showing a low rate of adverse events with LAMS, comparable with that of plastic stents, a recent rapid report by Varadarajulu and colleagues reported an extremely high rate of LAMS-related delayed adverse events in a randomized-controlled trial of the Hot AXIOS LAMS versus double-pigtail plastic stents in patients with WON [47]. They reported a 50% (6/12) rate of serious adverse events in patients treated with the LAMS in comparison with 0% (0/9) in patients treated with plastic double-pigtail stents. These adverse events included delayed bleeding in 3/12 (25%), buried stent syndrome in 2/12 (16%) and obstructive jaundice because of direct compression of the common bile duct by the LAMS in one patient, which developed following decompression of the WON.

Drainage and debridement of WON or direct endoscopic necrosectomy (DEN) is similar to the drainage of a pseudocyst, except that the fistulous tract is dilated and mechanical cleansing with the removal of necrotic debris is then performed (Fig. 4). Nasocystic drainage can be performed to facilitate liquefaction of the debris and improve drainage [48]. The extent/size of the WON seems to have an impact on the outcome of the drainage procedure. WON should never be drained with a single plastic stent because of the risk of stent occlusion and resultant infection/abscess formation [49]. If the collection is less than 10–12 cm, a single transluminal puncture site is generally adequate, with insertion of a FCSEMS/LAMS or at least two double-pigtail stents. However, if the WON collection is more than 12 cm, there is some evidence to suggest that multiple puncture sites into the collection, with insertion of multiple plastic or metal stents at different sites within the collection, the so-called multiple transluminal gateway technique, results in improved outcomes [49,50]. If the WON extends deeper into the flanks, then a hybrid or a multimodal drainage technique may be required, for example a combination of both an EUSGD and a percutaneous or laparoscopic drainage procedure may be required [49,50].

LAMS and FCSEMS allow for passage of a standard endoscope through the lumen of the stent into the cavity to facilitate mechanical necrosectomy. Studies using LAMS or FCSEMS in WON reported a clinical success rate of 81–95%, with an overall major complication rate varying widely between reports from 5.4 to 50% [47,51]. Complications included infection, which was caused by stent occlusion by necrotic debris, and in most cases, this could be managed endoscopically, bleeding and stent migration (internally, or so-called buried stent syndrome or externally) [47,52]. The incorporation of metal stents that allow for a large drainage lumen and the advancement of an endoscope through the stent lumen for DEN is a major advancement, which may ultimately improve efficacy and decrease the complications associated with these procedures [53–55]. Large studies into the efficacy of DEN are still required to provide data on optimal timing as well as efficacy, and indeed the necessity of DEN as adequate drainage of WON may be sufficient to allow resolution in most cases, without the need for DEN.

FCSEMS/LAMS are currently licensed to remain *in situ* for up to 3 months, after which time, it is recommended that they be removed. However, clinicians have left these stents in for longer in some instances. In patients who have a disconnected PD, there may be a risk of reaccumulation of the cyst fluid following removal of the stent as it is not clear at this juncture whether the relatively wide cystogastrostomy fistula site remains patent or whether it closes over time as is believed to occur in surgical drainage procedures (Fig. 5). There is an option of placing plastic pigtail stents through the established fistula at this point as the pigtail stents can be left *in situ* for an unspecified period. It has already been shown in patients who underwent successful EUSGD of pancreatic collections that stent removal was associated with higher recurrence rates in patients with PD disruption [56]. However, our experience (unpublished data) is that insertion of a pigtail stent can prove challenging in this situation as the PFC has collapsed. As experience with both the FCSEMS and the LAMS increases, information from prospective studies of metal stents should provide further information and may help inform decisions on the choice of stent in different scenarios, the optimal timing of postprocedure imaging and follow-up.

Cost is a significant consideration in all healthcare systems. Although the costs of the consumables involved in the insertion of a double-pigtail stent are lower than with the newer metal stents (both FCSEMS and LAMS), there is increased procedure duration, which has implications for staffing costs and patient turnover in busy endoscopy units. A recent study from the USA reported that the overall cost of treating pseudocysts by EUSGD with plastic pigtail stents was considerably less than with LAMS [46]. However, for WON, there was no overall difference in costs when using either plastic pigtail stents or LAMS [46]. The relative contribution of consumables, staffing costs and endoscopy suite time to overall costs will differ in diverse healthcare systems and may ultimately influence the choice of stent used.

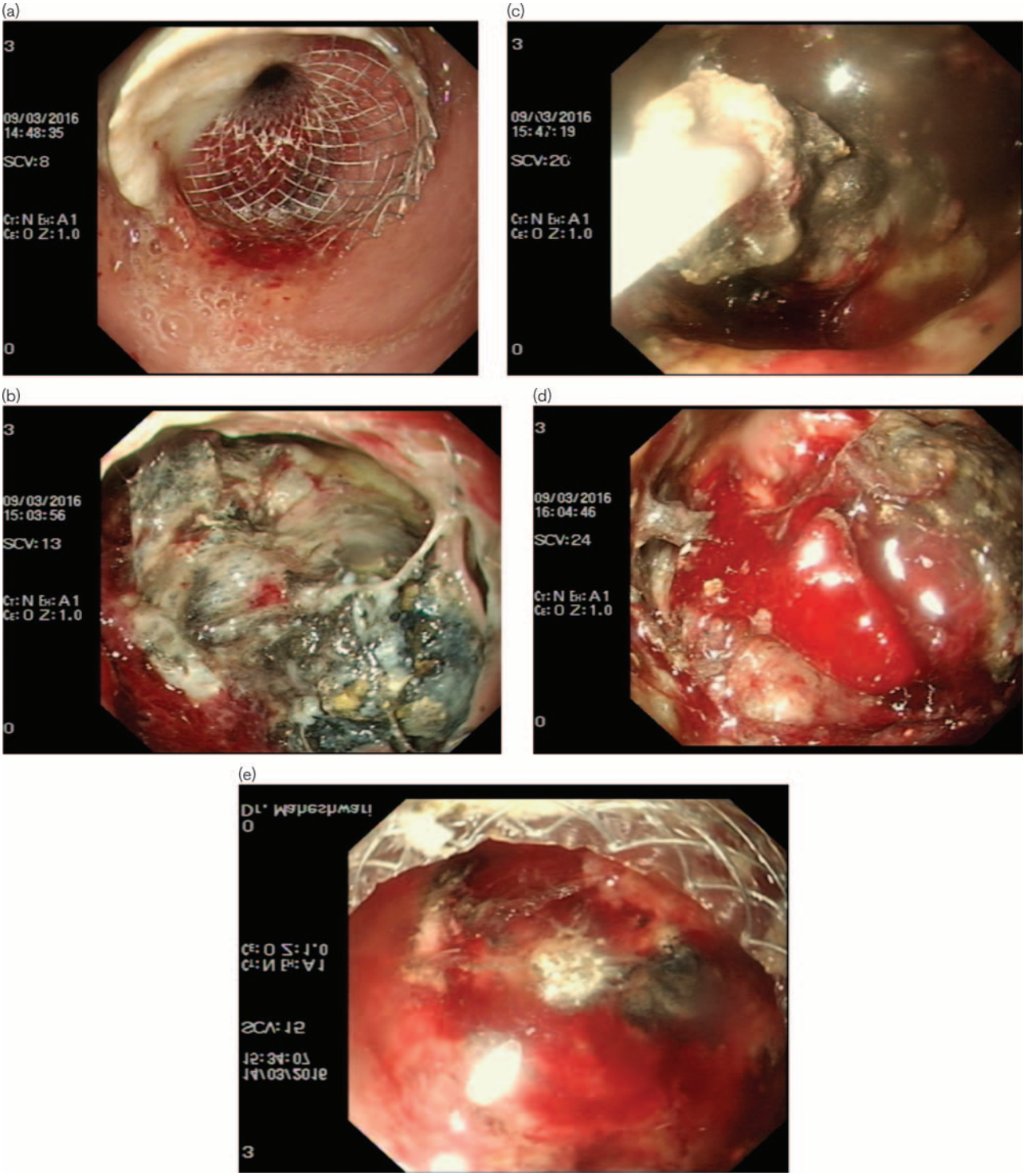

Fig. 4. Direct endoscopic necrosectomy of walled-off necrosis (WON). (a) Hot AXIOS LAMS in position, drainage of pus visible. (b) LAMS fistula track dilated and gastroscope inserted. Necrotic tissue visible within the cyst. (c) Debridement of the necrotic tissue using a 'cold' snare. (d) Following extensive removal of necrotic tissue, viable tissue is visible. (e) Endoscopic view of the WON 1 week later. Healthy tissue is seen. LAMS, lumen apposing metal stent.

Postprocedure care

In many cases, particularly in the setting of WON, the drainage procedure is performed on an in-patient basis and patients are monitored closely postprocedure. However, drainage of uncomplicated pseudocysts is an elective procedure and is frequently performed on a day-case basis. Postprocedure care is similar to that of any invasive endoscopic procedure such as ERCP. Some centres administer oral antibiotics postprocedure, but this is not universal and has not been studied prospectively. AQ6

Enteral nutrition should be considered in all patients with on-going pancreatic inflammation and is preferred to parenteral feeding in the context of a functioning gut [57]. This should be instituted after appropriate input from a dietician. Current practice is to repeat imaging of the

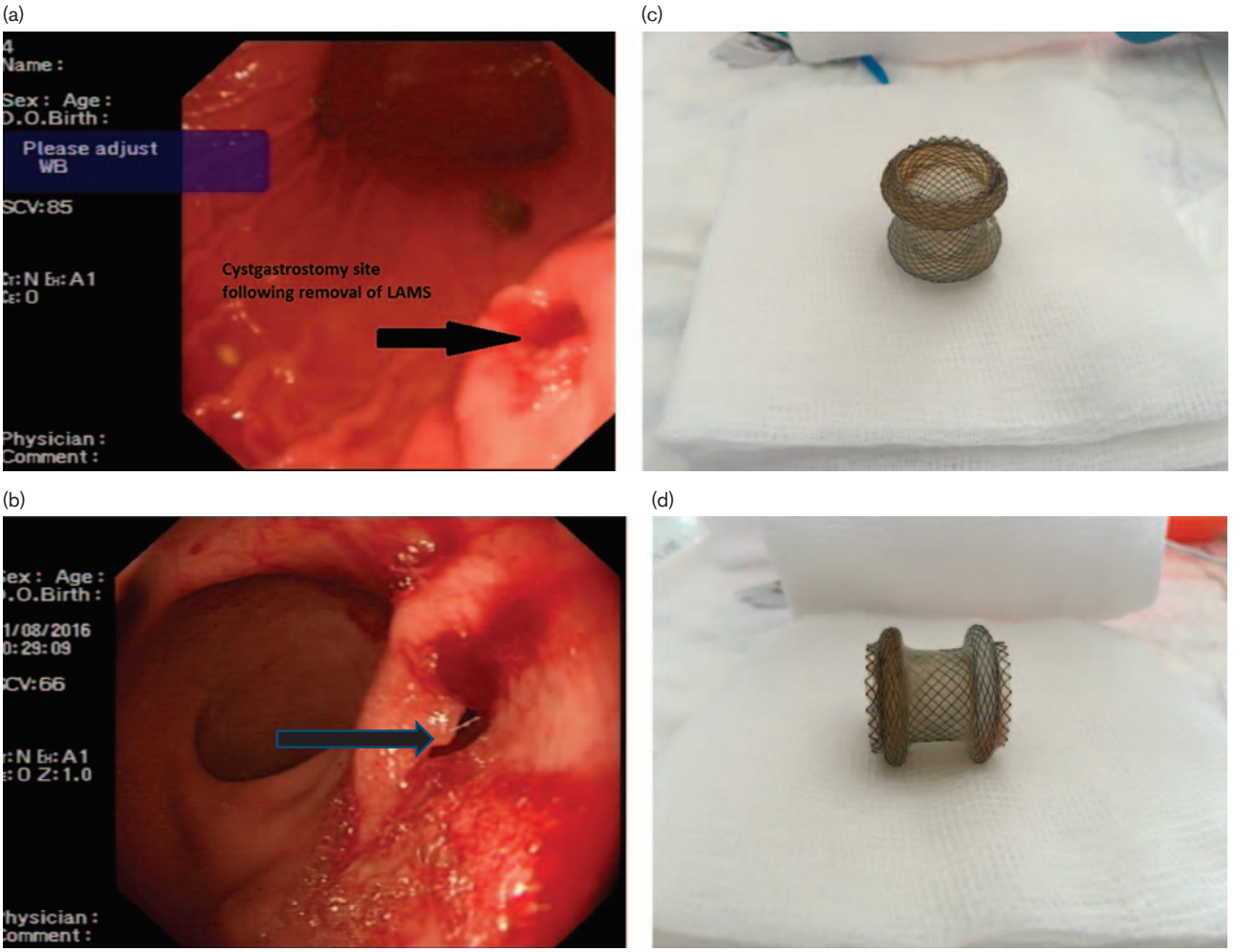

Fig. 5. Cystgastrostomy sites following the removal of LAMS along with stents. The block arrows in (a, b) show the appearance of the cystogastrostomy fistula site immediately after removal of a LAMS in two patients. (c, d) Two views of a fully deployed 15 mm diameter × 10 mm long biflanged Hot AXIOS stent following removal from a patient after 8 weeks *in situ*. LAMS, lumen apposing metal stent.

collection 4–6 weeks following EUSGD to assess treatment response/resolution of the collection. Ideally, a CT abdomen is performed, but transabdominal ultrasound or EUS can also be used. Following resolution, an OGD is performed to remove the stents. The optimal duration for which to leave the stents *in situ* has not been defined. The FCSEMS/LAMS are licensed to be left *in situ* for only up to 3 months because of the risk of the stent becoming buried, migration or erosion into vessel once the PFC has decompressed. Double-pigtail stents can safely be left *in situ* for prolonged periods and in some cases indefinitely.

Adverse events

As alluded to above, the main complications of the EUSGD procedure are bleeding, perforation or pneumoperitoneum, pain, stent migration outwards or inwards (buried stent syndrome), stent occlusion, infection and technical failure (Table 2). The reported rates vary widely, possibly related to the design of the studies, endoscopist experience and stent type used [47,51,58–66]. A recent systematic review of EUSGD for PFC drainage showed a wide variation in reported adverse events [60]. The pooled adverse event rates for plastic stents were 14.4% [95% confidence interval (CI): 11.3–18.1%] for pseudocysts and 17% (95% CI: 12–23.6%) for WON [58]. For metal stents, the pooled adverse event rates were higher: 24% (95% CI: 16.5–34.7%) for pseudocysts and 18.1% (95% CI: 5.9–43.9%) for WON. There was considerable heterogeneity in the metal stent studies in terms of the stent type used and the duration of follow-up, and the applicability of these figures to the newer biflanged LAMS currently more commonly in use is not clear. For example, our group recently reported a much lower serious adverse event rate with the Hot AXIOS LAMS of only 2.5% [42] and another recent study reported a serious adverse event rate of 0% for LAMS compared with 21.4% for pigtail stents [46], whereas the same group has recently reported an extremely high adverse event rate for LAMS in their own single-centre trial [47]. Clearly, further studies including larger numbers of patients are required to assess the risks. To minimize risk when performing a EUSGD, only collections with a mature wall and within 1 cm of the gastrointestinal lumen should be subjected to endoscopic drainage. Any coagulopathy, if present, should be corrected. Infection is usually a later complication, occurring from a few days to weeks following the procedure, and is

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Table 2. Complication rates with different types of stents

	Stent occlusion (%)	Bleeding (%)	Perforation (%)	Stent migration (%)	Infection (%)
DPS	2.7–13.6	0.7–5.1	3.7–4.2	0.75–1	3–10
LAMS	3.4–7	3.4–25	0–1.8	5.3–16	3
LAMS/ECE	0	1.2	1.2	1.1	NA

DPS, double-pigtail stent; ECE, electrocautery enhanced; LAMS, lumen apposing metal stent; NA, not available; WON, walled-off necrosis.

generally because of blockage or migration of the stent. This can usually be managed successfully endoscopically by clearance of the stent in the case of a FCSEMS/LAMS or insertion of fresh stents in the case of double-pigtail stents.

Conclusion

EUSGD of mature PFCs can be achieved in the majority of symptomatic patients who require drainage. Developments in medical devices over the past few years have significantly simplified and shortened the duration of the procedure itself, but the optimum choice of stent in different clinical scenarios remains to be defined, as does the place of endoscopic necrosectomy. Furthermore, where endoscopic management actually sits alongside surgical and percutaneous techniques, and the determination of which patients require multimodality treatment need to be further investigated in large, prospective, randomized trials. At present, it seems that the key to successful outcomes involves careful preprocedure workup and discussion in a multidisciplinary environment with long-term management by a group of individuals working in a high-volume pancreatic unit.

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Conflicts of interest

There are no conflicts of interest.

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