Gastroenterology 2017;153:364–381

REVIEWS IN BASIC AND CLINICAL GASTROENTEROLOGY AND HEPATOLOGY

Ernst J. Kuipers and Vincent W. Yang, Section Editors

Recent Advances in Endoscopy

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In this narrative review, invited by the Editors of *Gastroenterology*, we summarize recent advances in the field of gastrointestinal endoscopy. We have chosen articles published primarily in the past 2−3 years. Although a thorough literature review was performed for each topic, the nature of the article is subjective and systematic and is based on the authors' experience and expertise regarding articles we believed were most likely to be of high clinical and scientific importance.

There have been remarkable advances in the field of pancreaticobiliary endoscopy over the past 2 years.[1,2] In this section of the article, we will highlight major new publications relevant to pancreaticobiliary endoscopy since 2015.

Lumen-Apposing Metal Stents

Lumen-apposing metal stents (LAMS) represent what can only be called a disruptive change in therapeutic endoscopy. While plastic double-pigtail and metal stents used to drain pancreatic fluid collections (PFCs) have previously been limited to expanding lumens and providing passive conduits for drainage of immediately adjacent fluid collections, LAMS provide both drainage and expansion, but also physically pull together 2, non-apposing lumens, and with their large bore (10−15 mm) diameters, now provide a novel conduit to pass endoscopes and devices across lumens not previously accessible to endoscopes (Figures 1*A–D*). One LAMS device (Axios, Boston Scientific, Marlborough, MA) is Food and Drug Administration−approved and CE (Conformité Européene) marked and thus available throughout the United States and Europe. Multiple other LAMSs are available worldwide including the NAGI and SPAXUS stents, (Taewoong Medical, Gyeonggi-do, South Korea) resulting in rapidly expanding usage. Plastic stents, although less expensive then LAMS, are also safe and effective when draining PFC, including those involving pancreatic necrosis, but their overall usage is becoming less frequent in the age of LAMS. It should be emphasized that LAMS use for PFC and other indications is a relatively high-risk procedure.

In 2015, Walter et al[3] reported study results of 61 patients undergoing endoscopic ultrasound (EUS)−guided LAMS, primarily for the treatment of pancreatic walled-off necrosis (WON). Clinical success was remarkably high at 93% for patients with pseudocysts and slightly lower (81%) for patients with WON.[1] In an early US study, Shah et al[2] reported results of LAMS placement in 33 patients with either WON or pseudocysts (collectively referred to as pancreatic fluid collections). Technical success of stent placement was achieved in 30 of 33 (91%) patients, with double-pigtail stents reserved for LAMS failures. PFCs resolved in 93% of patients receiving LAMS. This includes approximately one-third of such patients who had necrosectomy performed via the LAMS. Adverse events were rare but included stent migration, pain, and infection at access site.[4]

In 2016, Siddiqui et al[5] reported results of their US multicenter retrospective cohort of LAMS for PFCs. Eighty of 82 included patients were treated with LAMS placement, primarily for WON. Clinical success was achieved in 100% of pseudocysts patients and in 88% of WON patients, most of whom also underwent endoscopic necrosectomy. Adverse events, including bleeding and stent maldeployment, occurred in 13% (10 of 80) of patients.

Continuing on this theme, Sharaiha et al[6] reported a retrospective multicenter evaluation of 124 patients who had LAMS placed for WON. As with other studies, clinical success was very high at 86%. In aggregate, these and other single and multicenter cohort studies demonstrate that LAMS have very high technical and clinical success rates for drainage of PFCs, with higher success rates seen in patients with pseudocysts than in those with WON. They are a particularly valuable alternative to traditional plastic stents in patients with WON because of the large-bore

Abbreviations used in this paper: **ADR, adenoma detection rate; AI, air insufflation; BDD, bile duct drainage; CAC, cap-assisted colonoscopy; CRC, colorectal cancer; cSEMS, covered metal self-expanding stents; CT, computed tomography; EMR, endoscopic mucosal resection; EoE, eosinophillic esophagitis; ERCP, endoscopic retrograde cholangiopancreatography; ESD, endoscopic submucosal dissection; EUS, endoscopic ultrasound; FNA, fine-needle aspiration; FNB, fine-needle biopsy; GBD, gallbladder drainage; GERD, gastroesophageal reflux disease; IBD, inflammatory bowel disease; LAMS, lumen-apposing metal stent; LSL, lateral spreading lesion; NBI, narrow-band imaging; OR, odds ratio; PEP, post-ERCP pancreatitis; PFC, pancreatic fluid collection; PIVI, Preservation and Incorporation of Valuable Endoscopic Innovations; POEM, per oral endoscopy myotomy; RFA, radiofrequency ablation; SAE, serious adverse event; SSA/P, sessile serrated adenoma/polyp; WDT, withdrawal time; WE, water exchange; WI, water immersion; WON, walled-off necrosis.**

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0016-5085/$36.00
http://dx.doi.org/10.1053/j.gastro.2017.06.014

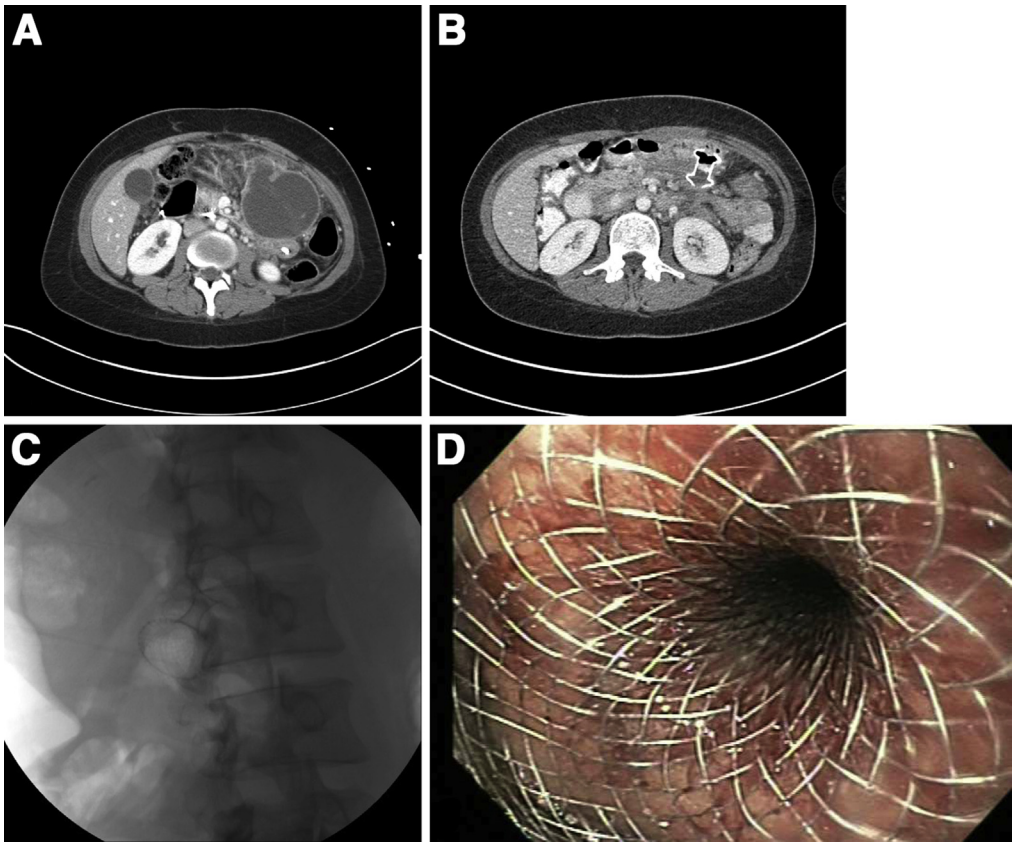

Figure 1. LAMS for drainage of a pancreatic pseudocyst. (*A*) CT image of pseudocyst fluid collection. (*B*) CT image after deployment of a LAMS. (*C*) Fluoroscopic image of stent. (*D*) Endoscopic image of the gastric lumen side of the stent.

(10−15 mm) lumen, which facilitates both passive drainage and active, endoscopic debridement via necrosectomy. It should be emphasized that although LAMS represent an improved technology for PFC drainage, these are still to be considered high-risk interventional procedures.

The success of LAMS when used for the drainage of various types of PFC has stimulated the evaluation and trial of these devices for other indications beyond their original design and intent. One of these is direct endoscopic gallbladder drainage (GBD). Indications include acute/chronic cholecystitis in patients who are poor operative candidates, and malignant biliary obstruction below the level of the cystic duct (such that upstream bile can flow directly to gallbladder and then drain via stent). In the latter case, LAMS GBD has the theoretical advantage of avoiding stent passage through a tumor and thus potentially lowers rates of stent occlusion from tumor ingrowth. Early data suggest that LAMS provide comparable efficacy and safety to percutaneous cholecystostomy drainage and potentially superior quality of life. This rapidly expanding literature, composed primarily of small cohort studies, has focused on a few areas of interest, including EUS-GBD for acute cholecystitis in poor operative candidates,[7–15] EUS-GBD for malignant biliary obstruction below the cyst duct takeoff,[16–18] long-term outcomes in nonsurgical candidates with cholecystitis,[19] and direct endoscopic cholecystoscopy via LAMS.[20]

Endoscopic Ultrasound−Guided Bile Duct Drainage

EUS bile duct drainage (BDD), like that of EUS-GBD, is also an area of intense interest, although still a rarely performed procedure. A meta-analysis reported in 2016 including almost 1200 patients demonstrated successful transgastric and transduodenal drainage, but also significant morbidity.[21] Similarly, a large single-center study of 101 patients treated with EUS-guided BDD reported technical and clinical success rates of 98 % and 92 %, respectively, but a moderately high adverse event rate of 12%, including 6 deaths, even with expert endoscopists doing the procedures.[22] Ogura et al[23] reported on 39 patients who underwent EUS-BDD by either choledochoduodenostomy or hepaticogastrostomy and found that hepaticogastrostomy patients had longer stent patency and fewer adverse events. Kawakubo et al[24] compared EUS choledochoduodenostomy and transpapillary stenting for distal biliary obstruction in 82 patients and found similar rates of adverse events and a shorter procedure time overall with EUS-guided drainage. No patients undergoing EUS-guided drainage developed post−endoscopic retrograde cholangiopancreatography (ERCP) pancreatitis. Overall, adverse event rates may be higher in transgastric BDD compared with transduodenal BDD, likely due to the potential for leakage into the gastro-hepatic space and the lack of dedicated devices for drainage. Currently, most procedures are performed with ERCP accessories in an off-label manner by a variety of nonstandardized techniques,