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LETTER FROM THE EDITOR

From a Diagnostic Tool to a Therapeutic Instrument: Interventional Endoscopic Ultrasound

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Endoscopic ultrasound (EUS) literature dates back to the 1980s, and the first report of its application in gastroenterology was published in the *Lancet* by Dimagno et al, entitled "Ultrasonic endoscope."[1] In its infancy, EUS was utilized for diagnostic imaging only, until the 1990s when an echoendoscope equipped with an accessory channel was introduced. Several EUS-guided interventions have been performed since the early 1990s, such as fine needle aspiration and celiac plexus neurolysis.[2–5] In recent years, however, we have witnessed multiple new EUS-guided interventions, with many becoming the treatment of choice for multiple diseases. Moreover, because of its increasing use, several new devices have been developed (eg, lumen-apposing metal stents [LAMS], microbubble contrast agents for harmonic EUS) or adapted from other specialties (microcoils, hyaluronate, sclerosants, cardiac angioplasty balloon, or multiple interventional radiology wires).

One of the primary therapeutic indications for interventional EUS is the drainage of mature pancreatic fluid collections.[6,7] Historically, double pigtail plastic stents were first used, followed later by biliary and/or covered esophageal self-expandable metal stents. The latter can facilitate direct endoscopic necrosectomy. Recently, LAMS have provided the latest technology to solve the various limitations of plastic stents and self-expandable metal stents. They provide cautery-enhanced placement with a larger caliber for easy cavity access, 2 anchoring-ends to decrease migration and are exclusively designed for EUS-guided placement.[8,9]

Biliary drainage (BD) and pancreatic duct drainage (PDD) can also be performed by EUS. Although endoscopic retrograde cholangiopancreatography (ERCP) is the standard of care for BD, it cannot be performed in some cases. EUS-guided BD was first reported in 2001 by Giovannini et al and represents an alternative approach (>90% success rate) when ERCP fails (Roux-en-Y anatomy, failed cannulation, and luminal obstruction). Two main different approaches have been reported with a good success rate: (i) Intrahepatic (by hepaticogastrostomy or by antegrade stent placement technique) or (ii) Extrahepatic (by choledochoduodenostomy or by Rendez-vous technique). Similarly, EUS-guided PDD can be performed primarily with a rendezvous approach or transmural antegrade stent placement (transgastric or transduodenal). EUS-guided BD or PDD is another modality for patients who are unable to undergo ERCP but require expert endoscopic skills. Whereas each technique has its own indications, no consensus exist to date about the first-line choice.[10–12]

In addition, EUS-guided transmural gallbladder drainage has been increasingly performed in recent years. When cholecystectomy was not possible, percutaneous drainage or ERCP with placement of a transpapillary plastic stent was traditionally performed. A decade ago, the first EUS-guided transmural drainage was performed by Baron and Topazian.[13] This approach has gained popularity when other approaches cannot be performed, and many successful cases have been published to date. The technique has evolved from the use of double pigtail plastic stent placement to the newer LAMS, which simplifies the puncture-dilation steps of the stent placement in a quick one-step fashion.[13–15]

Furthermore, EUS-guided transluminal ERCP in patients with altered anatomy is an excellent alternative. ERCP in patients with Roux-en-Y gastric bypass is challenging. Traditionally, balloon-assisted or laparoscopy-assisted ERCP has been attempted, but these methods are time-consuming, more invasive, and resource-utilizing. EUS-directed transgastric ERCP procedure is a new effective and less-invasive technique to manage patients who need to undergo Roux-en-Y gastric bypass. This procedure involves EUS-guided creation of a fistula with placement of LAMS from the gastric pouch or roux limb to the gastric remnant. ERCP can then be performed through the LAMS with a success rate of >90%.[16,17]

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Chen et al recently reported outcomes in 26 patients who underwent EUS-guided gastroenterostomy creation, a technique that is growing in popularity. Gastric outlet obstruction by a mechanical obstruction of the distal stomach or proximal duodenum can be managed surgically or endoscopically with an intrinsic stent placement. EUS-guided gastroenterostomy with LAMS placement, however, is a minimally invasive approach first described by Binmoeller et al in a porcine model in 2012, and since then many successful cases in humans have been reported. The technique bypasses the obstructed proximal duodenum with LAMS—from the stomach to the duodenum (gastroduodenostomy) or to the jejunum (gastrojejunostomy).[8,18–20]

Many upcoming EUS-guided interventions have been reported. (i) Contrast-enhanced harmonic EUS is for monitoring responses to chemotherapy, evaluation of effectiveness of local pancreatic cancer ablation therapy, and microbubble shells to target local delivery. (ii) EUS-guided angiotherapy is for the injection of a variety of agents (glue, microcoils, hyaluronate, sclerosants, fibrin products) under EUS guidance for refractory gastrointestinal bleed.[21,22] (iii) EUS-guided portal vein interventions such as portal venous sampling and/or pressure measurement are a growing interest on the utility of EUS-guided vascular access. In particular, its use for the measurement of circulating tumor cells or cancer-derived products was first demonstrated to be feasible and safe in humans in 2015 by Catenacci et al and later by Chapman and Waxman.[23,24] (iv) EUS-guided radiofrequency ablation (EUS-RFA) and photodynamic therapy is a growing field. It was first introduced by Goldberg et al in a porcine model in 1999. Recently, an EUS-RFA human study by Choi et al reported 10 patients with solid pancreatic tumor and demonstrated that EUS-RFA is a safe and potentially effective treatment for these patients.[25,26]

In addition, to perform interventional EUS, the gastroenterologist requires an additional training or advanced endoscopy fellowship. It is important to know that the pioneer endosonographers did not have the option of going into a formal advanced endoscopy fellowship to learn EUS. In early 1990, there were only 5 recognized advanced endoscopy fellowships in the United States. Interestingly, learning interventional EUS has gained popularity in recent years. A survey of advanced endoscopy fellowship applicants found that most applicants applied for this fellowship to gain access to procedures (92%), gain access to mentors (46%), and to learn a new set of advanced endoscopic skills (43%).[27,28] Lastly, there are pros and cons of doing an advanced endoscopy fellowship, and the decision should be individualized depending on future practice plans, passion for this continuously developing field, career goals (academic vs private), life/personal plans, and previous exposure to advanced endoscopic procedures.[29,30]

In conclusion, interventional EUS is a rapidly growing field, and the newly reported EUS-guided interventions can spare patients from major surgeries. Its outcomes are at least equivalent to or in some cases better than surgical approaches. EUS-guided interventions are cost-effective and have high technical success when performed in appropriate patients and by a well-trained endosonographer.

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