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Endoscopic ultrasound guided gastroenterostomy: Technical details updates, clinical outcomes, and adverse events

Wang J *et al*. Updates of endoscopic ultrasound guided gastroenterostomy

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Abstract

Endoscopic ultrasound-guided gastroenterostomy (EUS-GE) has been transformed from an innovative technique, into a viable alternative to enteral stenting and surgical gastrointestinal anastomosis for patients with gastric outlet obstruction. Even EUS-GE guided ERCP and EUS-guided gastrointestinal anastomosis for the treatment of afferent loop syndrome have been performed, giving patients more less invasive options. However, EUS-GE is still a technically challenging procedure. In order to improve EUS-GE, several techniques have been reported to improve the technical details. With EUS-GE widely performed, more data about EUS-GE's clinical outcomes have been reported. The aim of the current review is to describe technical details updates, clinical outcomes, and adverse events of EUS-GE.

Key Words: Gastric outlet obstruction; Endoscopic ultrasound guided gastroenterostomy; Endoscopic ultrasound; Retrievable anchor; Duodenal stent; Surgical gastroenterostomy

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Core Tip: Endoscopic ultrasound guided gastroenterostomy (EUS-GE) is still a technically challenging procedure. In order to improve EUS-GE, several techniques have been reported to improve the technical details. With EUS-GE widely performed, more data about EUS-GE's clinical outcomes have been reported. Knowledge of complications during performing EUS-GE is essential to perform it well. The aim of the current review is to describe technical details updates, clinical outcomes, and adverse events of EUS-GE.

INTRODUCTION

Based on the development of accessory devices, such as lumen-apposing metal stents (LAMS)[1], more interventional endoscopic ultrasound (EUS) procedures could be performed[2-4], including EUS-guided gastroenterostomy (EUS-GE)[5,6]. The first EUS-GE was reported in an animal study by Binmoeller *et al*[7] in 2012, demonstrating that EUS-GE was a technically feasible procedure. The indication of EUS-GE was initially for the treatment of malignant gastric outlet obstruction (GOO). With EUS-GE developing rapidly in the last five years, EUS-GE could be used to treat malignant GOO and benign GOO[8], as well as afferent loop syndrome[9-11]. Even EUS-GE assisted ERCP could be performed in patients with Roux-en-Y gastric bypass[12-15]. However, EUS-GE is a technically challenging procedure, because the intestinal cavity is small and small bowel is free. Adverse events, such as misplacement of metal stent, could occur during the procedure. In order to simply EUS-GE, several techniques have been reported[16-18].

The aim of the current review is to describe technical details updates, clinical outcomes, and adverse events of EUS-GE.

TECHNICAL DETAILS UPDATES OF EUS-GE

The direct EUS-GE is usually performed as follows: puncturing a small bowel loop adjacent to the stomach with a 22-gauge needle to dilate the target small bowel with saline. After puncture with a 19-gauge FNA needle, an enterogram is obtained and a wire is inserted through the needle into the small bowel. The tract is then dilated along the wire and the LAMS is placed. Based on direct EUS-GE, several techniques have been used to distend the jejunum, stabilize the target jejuna loop and simply the procedure.

It is of importance to know how to scan the suitable bowel to do EUS-GE. At first, when we scan the confluence of splenic vein and superior mesenteric vein, we can see the neck of pancreas, uncinate process and the second part of duodenum behind the uncinate process. We slightly rotate the endoscope, then we can see the bowel near to stomach and below the pancreas, which is a good place to perform EUS-GE (Figure.1).

To distend the jejunum, water-filling technique[19] and water-inflated balloon technique[20-22] have been used. For water-filling technique, before the performance of EUS-GE, a nasobiliary drain tube was usually inserted into jejunum over guidewire, through the stenosis, connected to a syringe. The saline with blue dye was injected into jejunum to distend intestinal lumen. The advantage of colored saline than only saline is that the pullback of blue saline by the needle can help confirm the successful puncture of jejunum, avoiding mispuncture of colon[23]. Instead of syringe, a waterjet system was used to constantly inject saline, which could be performed by the operator. For water-inflated balloon technique including single-balloon-occluded gastroenterostomy and double-balloon-occluded gastrojejunostomy bypass (EPASS), Itoi *et al*[24] first reported EPASS and it was widely used in clinical practice. In the EPASS technique, a guidewire and/or an overtube was used to facilitate passage of the double-balloon enteric tube into the jejunum beyond the ligament of Itoi *et al*[25] reported that a 0.89-inch large diameter guidewire was used to assist passage of the double-balloon enteric tube into the jejunum and a large diameter guidewire can avoid the looping of the balloon tube in the stomach fornix. The saline solution is only filled between two balloons over this area, making it easy to locate the distended jejunum under EUS guidance and allowing easy and safe access to the jejunum.

Because this device is not, however, available everywhere, an occlusive double-balloon device, using a widely available vascular balloon catheter, for EUS-GE has been reported[26].

To stabilize the target jejuna loop, the anchor wire[7] and retrievable anchor[27-29] was used to appose small bowel against the gastric wall. Small intestine is free in the abdominal cavity, which made EUS-GE difficult to perform. Any device to access small intestine might push small intestine away from the stomach, which made EUS-GE failed. Even with EPASS, two unsuccessful stent deployment cases occurred, due to guidewire pushing the distended jejunum to move away from the stomach[25]. So it is important to fix the small intestine. The distal end of the 0.035-inch wire has three triangular anchor components. The retrievable anchor is similar to T-tag anchor with a

retrievable wire. When performing EUS-GE, the small bowel was punctured with a 19-G FNA needle, the anchor wire or retrievable anchor was inserted through a standard 19-G FNA needle to appose the small bowel against the gastric wall. Both the anchor wire and retrievable anchor could be retrieved after EUS-GE.

To simply the EUS-GE, electrocautery-enhanced LAMS[30,31] was used, even wireless EUS-GE[32-35] was performed. As mentioned above, any device to access small intestine might push small intestine away from the stomach. Electrocautery-enhanced LAMS can combine the tract dilation with stent insertion, which reduces tract dilation step of EUS-GE. For wireless EUS-GE, after confirmation of the target loop, the electrocautery-enhanced LAMS was inserted directly into the targeted jejunal loop without using a guidewire. In their opinion, if we can observe the distended small bowel and nasojejunal catheter adequately under EUS, confirmatory puncture by a 19-gauge needle and guidewire cannulation is an unnecessary step; it increases costs and procedure duration and may provide a false sense of security. During this procedure, the power should be set to enable LAMS entering small intestine quickly, otherwise LAMS might push the small intestinal away.

CLINICAL OUTCOMES OF EUS-GE

With more articles about EUS-GE published in recent 5 years, systematic reviews and meta-analysis suggested that EUS-GE has good overall technical and clinical success, as well as acceptable complication rates, despite EUS-GE technique[36-38].

For success rate between different techniques of EUS-GE, only one study evaluated the direct and balloon-assisted techniques[39]. The two groups had similar technical success rate, clinical success rate, rate of complications, postoperative length of stay, need for re-intervention and survival, but the direct technique may be the preferred method, due to mean procedure time shorter with the direct technique ($P < 0.001$). All the medical centers included in this study were from United States and Europe and the single balloon-assisted EUS-GE was performed in this study. Further studies are expected to confirm the results.

The size of LAMS has been the subject of debate. The 15-mm LAMS has always been used to perform EUS-GE and it has been proven to be technically feasible, clinically effective, and safe. Madanat *et al*[40] first reported the use of the 20-mm LAMS for an EUS-GE. Theoretically, better clinical outcomes may be achieved with the 20 mm LAMS with a wider lumen. But it is concerned that 20-mm LAMS's wider luminal diameter and larger flange size may lead to difficulty in deploying. Sobani *et al*[41] reported EUS-GE with 20mm-LAMS is a technically feasible and safe option for patients with GOO allowing for tolerability of regular diet. A recent study compared 20-mm LAMS with 15-mm LAMS in performing EUS-GE. The type of diet tolerated at follow-up differed between the two groups, although clinical success was similar. A higher proportion of patients in the 20 mm LAMS group tolerated a soft/full diet compared to those in the 15 mm group (P = 0.04)[42]. The 20-mm LAMS is, thus, the preferred LAMS during EUS-GE.

Through maturation of the EUS-GE technique, EUS-GE was compared with surgical gastroenterostomy (SGE)[43-45] and enteral stenting for the treatment of GOO[46-48]. In several retrospective studies, EUS-GE has been proposed as an alternative to enteral stenting with similar safety and surgical range-efficacy. The most recent systematic review, including 625 patients, comparing EUS-GE with SGE showed that the pooled odds of technical success were lower for EUS-GE compared to SGE. Among the technically successful cases, EUS-GE was superior in terms of clinical success, lower overall AE and shorter procedure time. There was no significant difference about rates of severe AE and GOO recurrence between EUS-GE and SGE. The results suggested EUS-GE is a promising alternative to SGE because of its superior clinical success, overall safety, and efficiency[49].

Compared with enteral stent (ES), a recent systematic review including 659 patients demonstrated that EUS-GE and ES has a similar technical and clinical success rate, but the pooled re-intervention rate was significantly lower for EUS-GE than ES[50].

ADVERSE EVENTS OF EUS-GE

Knowledge of adverse events encountered with EUS-GE is essential to perform it well. The EUS-GE-related complications included LAMS misdeployment, abdominal pain, bleeding , infection , leakage at the site of the LAMS, gastric leak , stent ingrowth, stent failure, and LAMS mesh erosion[43,45,48,51,52].

LAMS displacement is the most typical adverse event evaluated in the largest multicenter cohort to date, and the different types of stent displacement were classified into four types[53]. Type I was defined as distal flange of stent displaced in the abdominal cavity without enterotomy. Type II was defined as distal flange of stent displaced in the abdominal cavity with concomitant enterotomy. Type III was defined as distal flange of stent into the small bowel and proximal flange of stent in the abdominal cavity. Type IV was defined as gastrocolonic anastomosis. Type I stent displacement was the most common among four types. For both type I and type II stent displacements, the majority of patients can be successfully managed by endoscopic methods or conservative treatment. Type I stent displacements were more frequently rated as mild than type II stent displacements. Depending on the type of stent displacement, it is important for endoscopists to have a better understanding of the implications and possible consequences of stent displacement. Depending on the subtype, the majority of stent displacement can be successfully managed by endoscopic salvage. Several rescue options have been previously reported for gastroenterostomy[54-59]. The rescue method was usually based on the status of guidewire. If the guidewire could not enter the target loop again, LAMS misdeployment can require natural orifice transluminal endoscopic surgery. For the most common situation, distal LAMS flange misplacement, we could enter peritoneal cavity through transgastric LAMS using a therapeutic gastroscope or double-channel gastroscope and put a second stent to form LAMS-in-LAMS salvage. If the guidewire kept in the target loop, a second stent can be deployed safely under peritonoscopy and fluoroscopy guidance[60].

Delayed intestinal perforation, caused by LAMS, were reported which was related with indwelling time[61,62]. Although the manufacturer recommends removal of the LAMS within 60 d of placement, this period is theoretical as no study has evaluated the

optimal indwelling time. The stent indwelling time was different, depending on causes of GOO. For malignant GOO, palliative stents should be left in place for as long as possible. For diseases that may be reversible, such as GOO due to acute pancreatitis, where the pancreatitis may resolve after treatment, these stents should be removed as soon as the GOO resolves. For patients with nonreversible benign GOO, there is still no data to confirm the safety of long-term use and we should be cautious.

CONCLUSION

EUS-GE is an effective method to treat GOO, even for afferent loop syndrome and EUS-GE guided interventional procedure. An increasing data has demonstrated that EUS-GE may be a more effective alternative to enteral stenting and surgical gastroenterostomy. No standardized technique of EUS-GE has been confirmed and endoscopists perform it based on their habit. Randomized controlled studies are needed to confirm the standardized technique. Because EUS-GE is initially for the treatment of malignant GOO, most of studies focused on short outcomes. With EUS-GE performed for benign GOO, the ideal indwelling time of LAMS and long-term outcomes should be studied by large-volume prospective studies. Now almost all the EUS-GE procedures are performed in the tertiary medical centers. The training model should be studied to make EUS-GE more widely used.

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