Endoscopically directed single-port intragastric fundoplication, sleeve gastroplasty, and myotomy: a preclinical study in a porcine model

Ariosto Hernandez-Lara, MD, Barham K. Abu Dayyeh, MD, MPH, Ana Garcia de Paredes, MD, Elizabeth Rajan, MD, Andrew C. Storm, MD

The progress of endoscopic therapy in the upper GI tract is limited by the size of the endoscope working channel and by the need to achieve triangulation for instrumentation. A novel transgastric trocar (Endoscopic Trans-Abdominal Gastric Surgery System [Endo-TAGSS, LLC, Shawnee, Kansas, USA]; Kansas City, Mo, USA) has been developed to allow intraluminal therapy using a combined endoscopic and laparoscopic approach (Fig. 1).[1,2] The device, not yet Food and Drug Administration approved, is deployed under endoscopic vision with a technique similar to a pull PEG (Fig. 2), and it has been shown to be safe in a preclinical study that evaluated tract closure upon trocar withdrawal.[3] In addition to enabling the introduction of rigid laparoscopic instruments, the trocar offers improved orientation and tissue manipulation within the stomach and may facilitate the performance of advanced therapeutic procedures.[4] The incision in the abdominal and gastric wall is about 10 to 12 mm to fit the gastric trocar, and dilation is not required. The location for the trocar insertion may vary, with the surgeon choosing one that allows triangulation and maneuvering according to the type of procedure. Potential contraindications to the use of the novel device are the same as those for PEG.[5,6]

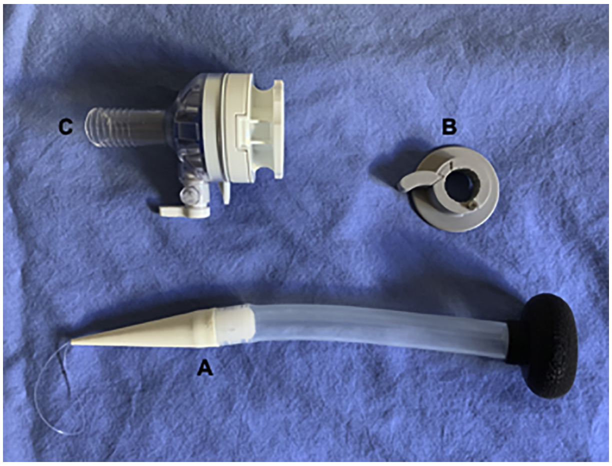

Figure 1. Endo-TAGSS components. **A,** Cannula with a removable headpiece with a monofilament loop and an internal bumper. **B,** External disc to secure the cannula against the anterior abdominal wall before surgical instrumentation. **C**, Endoscopic-laparoscopic intragastric trocar with a self-sealing cap.

The primary aim of this nonsurvival study was to assess the feasibility of this novel endoscopic device in performing different intragastric procedures with a laparoscopic articulated stapler (45-mm and 60-mm cartridges; Ethicon-Echelon Flex, Cincinnati, Ohio, USA) in a porcine model (Video 1, available online at www.giejournal.org). The study, including 2 domestic pigs, was approved by the Institutional Animal Care and Use Committee. A necropsy was performed after the procedures to assess for adverse events.

PROCEDURE 1: FUNDOPLICATION

To evaluate the feasibility of performing a partial fundoplication, a through-the-scope helix device (Apollo Endosurgery, Austin, Tex, USA) was used to pull the target tissue from the gastric cardia into the jaws of the laparoscopic stapler. Extraction of the resected tissue was achieved both peroral and through the intragastric trocar. A final pass with the gastroscope demonstrated a narrowing of the esophagogastric junction. A retroflexed view of the fundus and cardia showed no adverse events (Fig. 3).

PROCEDURE 2: SLEEVE GASTROPLASTY

A similar technique was applied to perform an intragastric stapled gastroplasty using a through-the-scope helix device to grasp tissue from the anterior gastric body starting from the distal part of the gastric body. Following a linear pattern through the length of the gastric body, after using 5 cartridges, a significant reduction of the gastric cavity was observed. The stapling device's articulating joint allowed the stapler to reach and effectively perform gastroplasty even in areas very proximal to the trocar with no adverse events (Fig. 4).

PROCEDURE 3: MYOTOMY OF LOWER ESOPHAGEAL SPHINCTER

In a second animal, we examined the feasibility of gastroesophageal myotomy (Fig. 5). Tissue was grasped using a through-the-scope helix device. Tissue from the

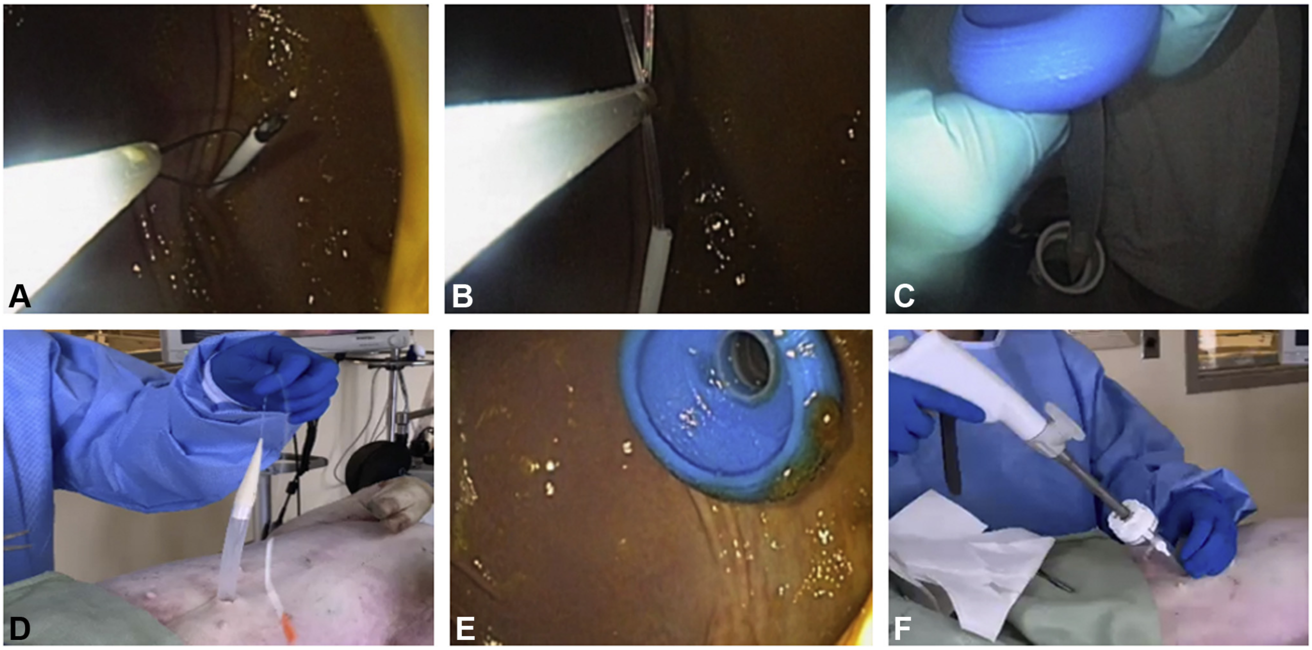

Figure 2. Deployment of the Endo-TAGSS intragastric trocar under endoscopic vision with a technique similar to a pull PEG with a standard gastroscope. **A,** After identifying the puncture location in the abdominal wall via transillumination, a needle is passed through the abdominal wall into the stomach. **B,** A wire is inserted through the needle and recovered from the stomach through the mouth with a through-the-scope snare. **C,** Once outside, the cannula is secured to the looped end of the wire, and the wire is pulled from the stomach wall. **D,** The cannula emerges out of the incision site. **E**, The internal bumper is against the gastric mucosa. **F,** The intragastric trocar is attached to the abdominal part of the cannula and secured through the external disc. Once in place, the tapered headpiece is exchanged for a self-sealing introducer cap, and laparoscopic tools may be inserted through the device into the stomach.

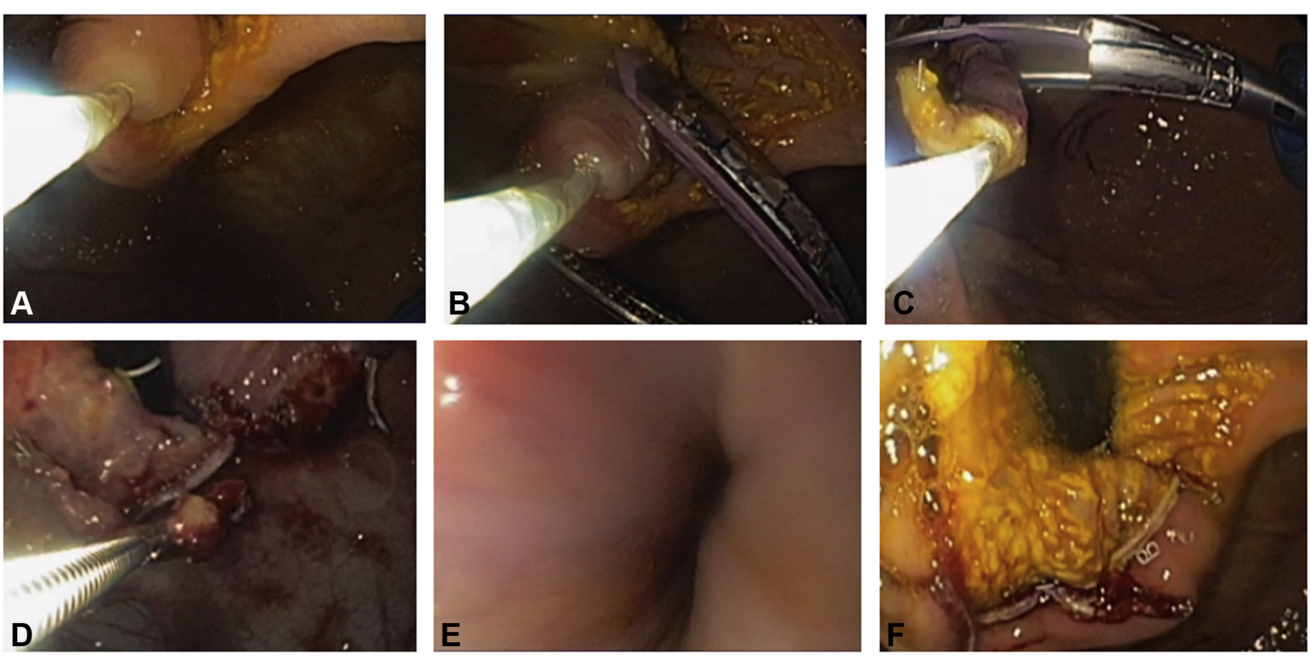

Figure 3. Endoscopically directed single-port intragastric fundoplication. **A,** Tissue from the gastric cardia pulled with a through-the-scope helix device. **B,** Pulled tissue is inserted between the stapler jaws. **C**, Once the target tissue is within the jaws of the stapler, it is released. **D,** Resected tissue is retrieved. **E**, Final pass with the gastroscope demonstrated a narrowing of the esophagogastric junction. **F**, Retroflexed view of the fundus and cardia after fundoplication.

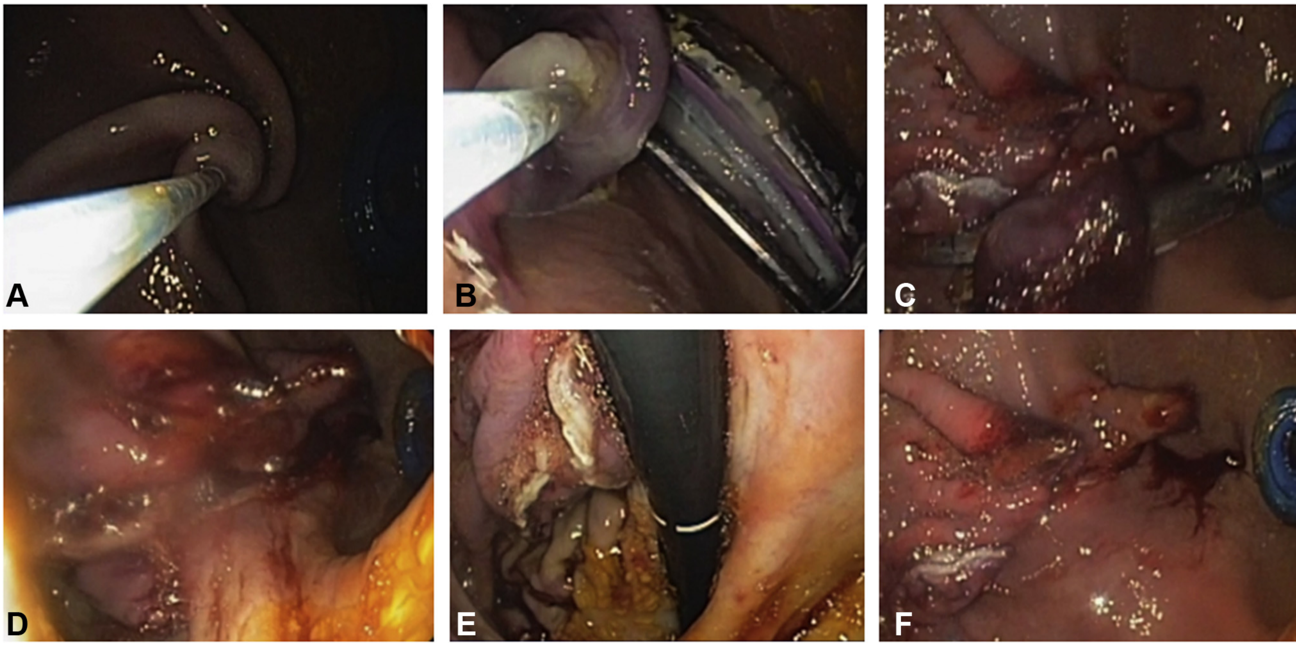

Figure 4. Endoscopically directed single-port intragastric sleeve gastroplasty. **A,** A helix device is used to grasp tissue from the anterior gastric body. **B,** Pulled tissue is inserted between the stapler jaws. **C, D,** Tissue is resected following a linear pattern through the length of the gastric body. **E,** Retroflexed view visualizing the resected line in the proximal gastric body. **F,** Significant reduction of the gastric cavity.

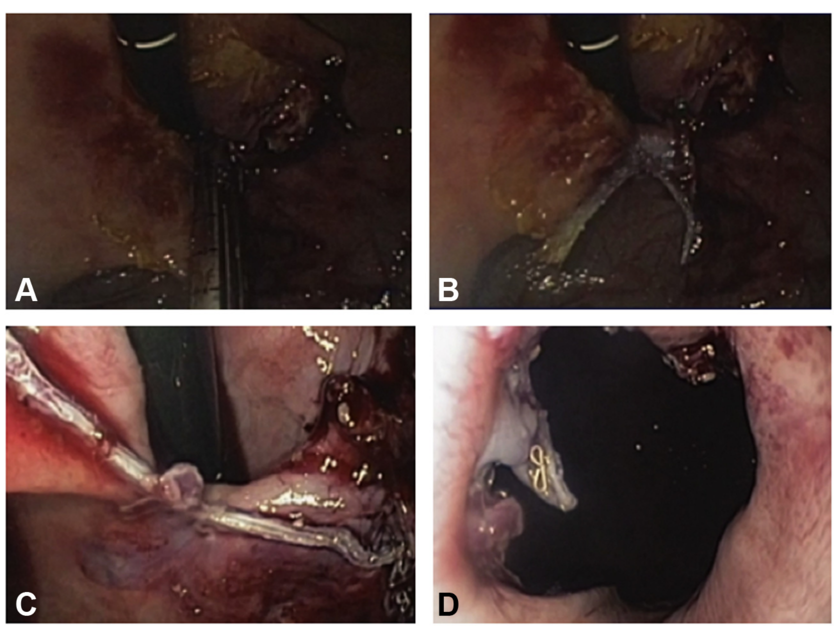

Figure 5. Endoscopically directed single-port intragastric myotomy. **A,** Tissue from the gastroesophageal junction is grasped within the stapler. **B, C,** Resected tissue simulates a myotomy. **D**, On endoscope retrieval, the gastroesophageal junction is visibly more patent.

gastroesophageal junction was brought within the jaws of the transabdominal stapling device, and 2 staple cartridges were fired linearly, progressing upstream within the junction to simulate a myotomy. On endoscope removal, the gastroesophageal junction is visibly more patent after transection and stapling of the gastroesophageal junction. No adverse events were observed. The endoscopically directed single-port approach may allow myotomy to be performed in a shorter time compared to conventional endoscopic methods (mean time of 94 ± 44 minutes for peroral endoscopic myotomy,[7] whereas it took less than 20 minutes in our pilot study).

In both animals, before removal of the transgastric trocar device, a guidewire was passed through the trocar to

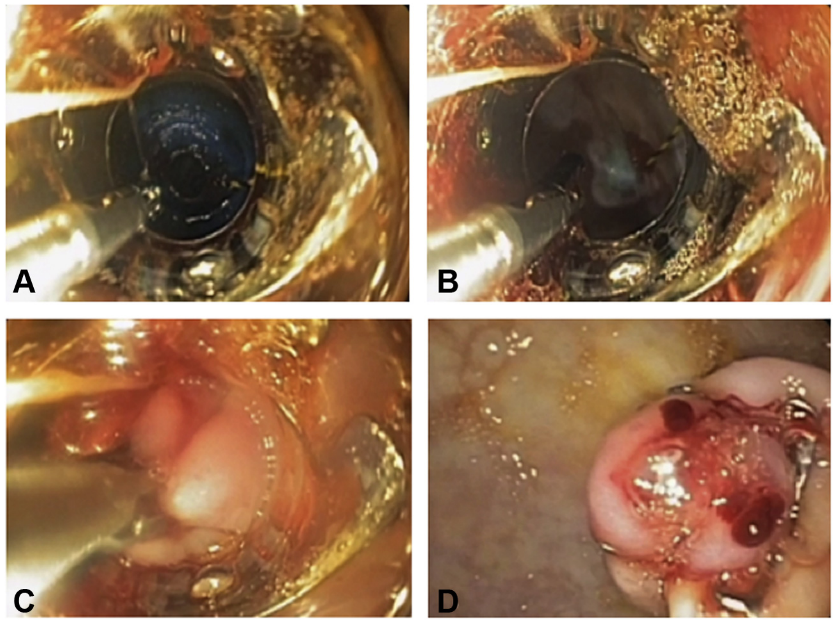

Figure 6. Tract closure with an over-the-scope clip. **A,** A guidewire is inserted through the transgastric trocar. **B,** The trocar is removed. **C,** The track is closed with an over-the-scope clip. **D,** Final examination of the gastric cavity demonstrates adequate closure of the trocar insertion.

ensure visualization of the introduction site after trocar removal. Once the trocar was removed, a through-the-scope twin grasper was used to bring the edges of the gastric defect together before an over-the-scope clip (Ovesco Endoscopy AG, Tübingen, Germany) was deployed for tract closure (Fig. 6). No closure was performed on the external PEG site because this was a nonsurvival study. However, the external PEG site can be closed as a conventional trocar insertion site with nonabsorbable suture or skin staples. The final examination of the gastric cavity with a leak test at necropsy demonstrated adequate closure of the trocar insertion site.

The novel system allows the use of laparoscopic and endoscopic instrumentation by providing gastric access through a single percutaneous transabdominal cannula, enabling interventions at the gastroesophageal junction and the stomach. Future preclinical studies are needed to ensure the safety and objectively assess the effectiveness of these procedures in the short and long term.

DISCLOSURE

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Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, Minnesota.

If you would like to chat with an author of this article, you may contact Dr Storm at storm.andrew@mayo.edu.

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