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Per Oral Pyloromyotomy for Treatment of Gastroparesis in a Pediatric Patient

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The use of endoscopic intervention as a modality to treat various gastrointestinal motility disorders is swiftly gaining popularity in not just the adult, but also the pediatric population. The development of per-oral endoscopic myotomy (POEM) for management of esophageal motility disorders like achalasia has certain advantages over Heller myotomy, including shorter length of stay with similar clinical outcomes (1). The techniques used for POEM, namely a submucosal dissection, exposure of the lower esophageal sphincter, and division of the sphincter were soon appealing as maneuvers that may be applicable to other gastrointestinal pathologies such as gastroparesis. The peroral endoscopic pyloromyotomy (POP), also known as gastric-POEM was introduced as an alternative to laparoscopic pyloroplasty or pyloromyotomy for benign gastric outlet obstruction once patients have failed nonoperative management with pyloric dilations and/or Botulinum toxin injections. POP technique was first performed in a porcine model in 2012 by Kawai et al (2) with the first human case reported in 2013 by Khashab et al (3). Similar to POEM, POP involves creating a submucosal tunnel followed by the division of muscles causing the obstruction. Outcomes from studies evaluating POP for treatment of gastroparesis demonstrated its safety as well as symptom improvement (4). Contemporary studies suggest POP has equivalent clinical outcomes with similar rates of adverse events, and shorter length of stay, operative time, and estimated blood loss (5).

The most common pyloric pathology in the pediatric population is congenital hypertrophic pyloric stenosis, occurring in 2–3/1000 live births (Table 1). Despite concerns of feasibility of POP due to small patient size and tightness of the pylorus, the procedure was first successfully performed in 2019 by Kozlov et al (6) on a full-term 1-month-old infant and subsequently on a 35-day-old infant with congenital hypertrophic pyloric stenosis (7). Data around gastroparesis in children are sparse and the exact prevalence is not known. Current treatments for gastroparesis in children include medical management (ie, promotility agents, continuous gastric feeds, postpyloric feeds, elemental formulas, blenderized feeds), pyloric dilations, Botox injections, electrical stimulation, and surgical pyloroplasty, similar to the adult population. As a disease with multiple and evolving treatment modalities, POP may serve as an intermediate step before escalation to pyloroplasty. To the authors knowledge, the below case report describes the first POP performed in a child for gastroparesis is as well as the first pediatric POP performed in the United States.

CASE REPORT

A 12-year-old male with a history of autism spectrum disorder and oral aversion initially presented with intolerance of gastric feeds with abdominal pain and bloating at the age of 10. He underwent a series of esophagogastroduodenoscopies, each of which revealed pyloric narrowing for which he was subsequently dilated 2 times without relief of symptoms. He did not experience symptom improvement on erythromycin for gastric motility or periactin for gastric accommodation, and experienced skin peeling with the former. Metoclopramide use was deferred due to the black box warning of tardive dyskinesia. Peptide-based and elemental formulas were trialed without success. The patient did best with blenderized feeds, though still required slow continuous feeds. He had a repeat esophagogastroduodenoscopies at age 11, this time with pyloric Botox (100 units) and dilation. He experienced 4 months of relief of pain, emesis, nausea, and early satiety. Repeat gastric emptying scan documented improvement with a 2-hour emptying measurement of 55% and a 4-hour measurement of 86%. Due to short-lived improvement and ongoing concern for malnutrition, he was transitioned to jejunal feeds and underwent antroduodenal manometry.

Antroduodenal manometry was concerning for neuropathic dysmotility with intermittent retrograde contractions in the distal small bowel leads during phase III migrating motor complex as well as premature return of phase III migrating motor complex in the postprandial state. He was also noted to have high pyloric amplitude both at rest (366 mmHg), during meal (450–560 ppm), and postprandially (560–570 mmHg). Given the ongoing concern for pyloric obstruction

TABLE 1. POP supply list

POP supply list
• Video tower: (Olympus) 180/190 series, HDTV
• GIF-H180 Olympus Endoscope with CO_2 insufflation
• ERBE VIO 300D generator; generator ground pad
• Apollo OverTube
• Lifting solution (2 mL methylene blue in 100 mL normal saline)
• Injection needle: Olympus NM-400L-0423
• Dissecting cap: Angled-Olympus MAJ-Y0173
• Hemostatic graspers: Olympus FD-411UR or LR
• Triangle tip knife: Olympus KD-640L
• Clips: Large-Boston Scientific Resolution clip M0052260 (open/close); Micro Tech Endoscopy Sure Clip 132-5724 (open/close/rotate)

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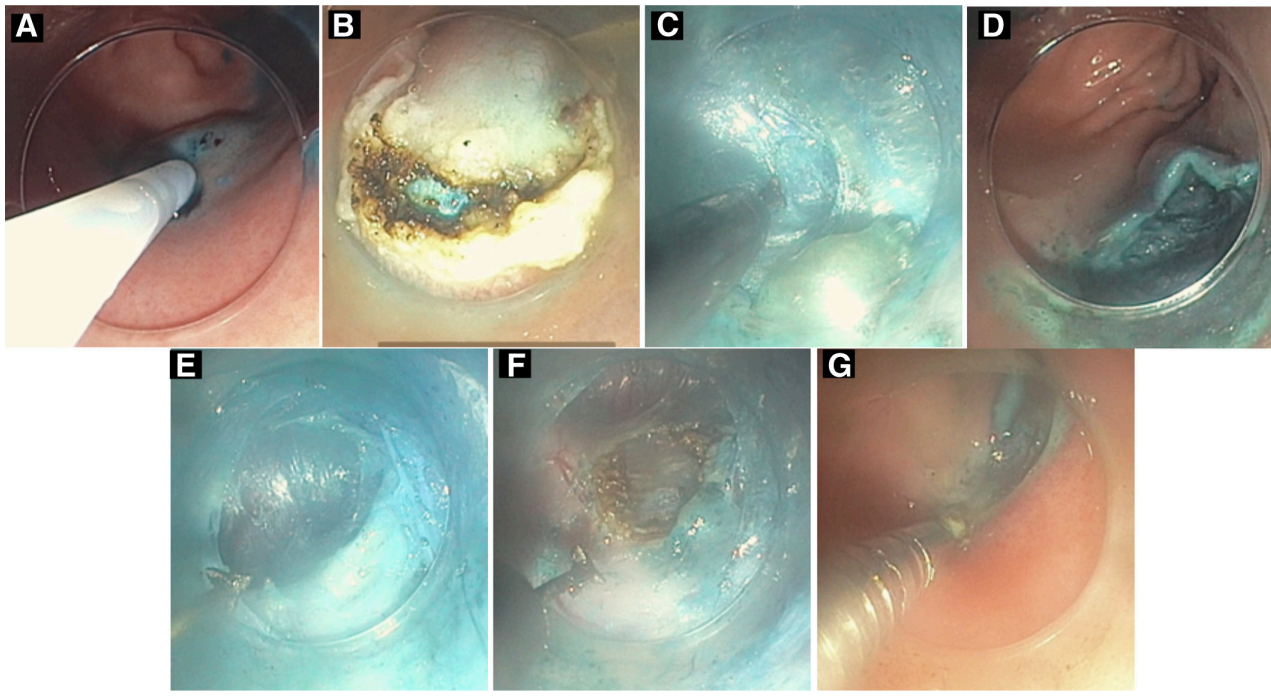

FIGURE 1. Steps of the POP as performed.

as one of the contributors to the patient's feeding intolerance and his failure of non-operative management, he was evaluated for POP versus laparoscopic pyloroplasty. After an in-depth discussion, the family elected to proceed with POP. The POP procedure is an extension of an established Pediatric Per-Oral Endoscopic Myotomy clinical program that has completed 25 procedures without a major adverse event. IRB approval was attained for the initial use of the POEM technique in children.

The pediatric surgeon performing the procedure has performed 25 Per-Oral Endoscopic Myotomies of the Lower Esophageal Sphincter in children over the past 7 years and was trained under the tutelage of an adult surgeon experiences in POEM. The surgeon also completed an additional year of fellowship training in adult minimally invasive surgery which included advanced endoscopy.

The procedure was performed using a GIF-H180 high-definition gastroscope with a single 2.8 mm working channel (Olympus, Center Valley, PA) (Table 1). The mucosa was elevated using a submucosal injection of methylene blue mixed with saline (Fig. 1A), 5 cm proximal to the pylorus (Fig. 1B). A 2 cm transverse incision was made in the mucosa (Fig. 1C). A tunnel was created through the submucosal plane to the level of the pylorus muscle using a combination of blunt dissection, triangle tip cautery (Olympus), and methylene blue injections to open and define the submucosal plane (Fig. 1D). The scope was intermittently placed back into the native lumen to ensure the correct direction of the tunneling toward the pylorus. The pylorus muscle was identified in the tunnel (Fig. 1E) and completely divided using electrocautery (Fig. 1F). The submucosal tunnel was irrigated with Bacitracin-infused saline while

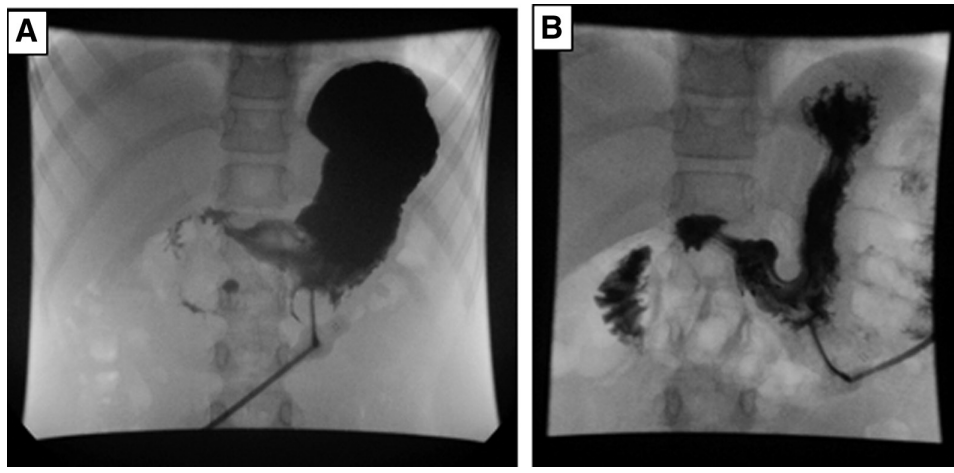

FIGURE 2. A, Preoperative barium UGI study. B, Postoperative UGI study demonstrating a more relaxed pylorus.

withdrawing the scope. Following the procedure, the pylorus was visibly more open than at the beginning of the procedure. The mucosal incision was closed using 7 endoscopic clips (SureClip, Microtech Endoscopy, Ann Arbor, MI) (Fig. 1G).

DISCUSSION

The POP procedure was performed in 134 minutes. Postoperatively the patient was admitted to the pediatric ward and kept NPO for the first 24 hours. On post-op day 1, he underwent an upper GI study which confirmed a sealed tunnel and no leak at the site of the pyloromyotomy (Fig. 2). He was started on slow intermittent gastric feeds and advanced over several days until he was able to tolerate bolus gastric feeds. He still had difficulty tolerating bolus feeds, so he was discharged on post-op day 5 on continuous feeds. He was subsequently transitioned to gastric bolus feeds 2 weeks after discharge which he continues to tolerate 5 months postprocedure. He is also tolerating meals by mouth without discomfort for the first time. Although this is a very short follow up, the results are promising given his long history with feeding intolerance.

CONCLUSIONS

A POP was successfully performed in a pediatric patient for the indication of gastroparesis by a pediatric surgeon with experience in advanced endoscopic procedures. Despite promising results, this procedure is still experimental and should not be performed as a first-line surgical therapy in pediatric patients until additional studies are performed. As endoscopic interventions become more advanced with the development of new technologies and techniques, pediatric specialists should learn and adapt techniques with the goal of improved clinical outcomes and recovery for pediatric patients.

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