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Gastric endoscopic remodeling techniques

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ABSTRACT

The stomach has been an obvious target for endoscopic remodeling to facilitate weight loss. Success is shaped by many challenges that must be addressed. The key challenges include mimicking or improving upon existing (permanent) surgical therapies, recognizing the body's response to foreign objects and materials, and understanding the neurenteric pathway as it relates to meals, hunger, satiation, and satiety. Early remodeling efforts failed because of technical limitations and limited understanding of the physiology of weight loss applied to the stomach. Current methods, especially the endoscopic sleeve gastroplasty, use improved technology and continue to be modeled on ongoing research into the physiology of changes made within the stomach.

1. Introduction

The recent American Society for Gastrointestinal Endoscopy (ASGE) Bariatric Endoscopy Task Force systematic review and meta-analysis highlights key issues surrounding the flexible endoscopic endolumenal management of obesity [1]. Several observations can be made. The epidemic numbers of overweight and obese patients in the United States and worldwide who may benefit from a weight loss procedure are overwhelming. Surgical weight loss procedures, restricted to the morbidly obese, are limited by appeal, availability, costs, and risks, both short-term and long-term. Lifestyle modification (diet and exercise) and drug therapies are burdened by limitations in outcomes. Because of these well-documented issues, endoscopy offers an intuitive pathway for primary, supplemental, and bridging weight loss therapies. Although the "pathway" may be intuitive, there are significant challenges to developing successful endoscopic weight loss options.

Predevelopmental thoughts about a gastric endoscopic bariatric procedure are typically driven by the simple notion of a restrictive procedure. The reality of success in this endeavor is shaped by many challenges that must be addressed. These challenges can be divided into at least 3 broad categories: (1) mimicking or improving upon existing (permanent) surgical therapies, (2) recognizing the body's response to foreign objects and materials, and (3) understanding the neurenteric pathway as it relates to meals, hunger, satiation, and satiety.

The Roux-en-Y gastric bypass, the sleeve gastrectomy, and the Lap-Band dominate surgical therapies for metabolic surgery. Other operations such as the duodenal switch and the vertical-banded gastroplasty are less commonly performed as in the former and virtually abandoned with the later operation. Experiences with endoluminal antireflux therapies, since their inception in the early years of this century, inspired the early efforts at gastric remodeling which was dramatically advanced by further experiment and real-time clinical practice with the availability of reliable endoluminal full-thickness suturing. Remodeling the foregut based on speculation as to how it may ultimately affect appetite, hunger, and satiety requires concomitant study of developing methods with neurenteric physiology to confirm what is being induced and how it can be improved. This last piece is critical for a remodeling technique to prevail and guarantee weight loss. We can certainly remodel the foregut to make people sick and lose weight and we can also remodel the gut with an understanding of mechanisms that will allow safe and physiological weight loss.

The ultimate goal of a flexible endoscopic remodeling weight loss procedure is to provide a safe, durable, and effective means to enable weight loss. This must be accomplished with relative simplicity so that many practitioners can adopt it. Owing to the tremendous forces of deconstruction, the body directs at endolumenally placed materials within and through the gastric wall, and the extreme challenge of duplicating one-time surgical procedures, it must also be considered a "fluid" technique, one that can offer effective supplemental intervention through time.

Christopher J. Gostout is a consultant medical advisor to Apollo Endosurgery. He holds equity and IP within this company. He is a consultant with Olympus Medical Systems and has conducted sponsored research. Barham Abu Dayyeh is a consultant for Apollo Endosurgery. He has conducted sponsored research for GI Dynamics, Aspire, and Metamodix. Elizabeth Rajan has no conflicts of interest.

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The remainder of this article presents a review of early efforts at remodeling of the stomach and the currently available gastric remodeling techniques with an emphasis on their safety and efficacy.

2. Early endoscopic gastric remodeling efforts

Gastric volume restriction is an important component of surgical weight loss procedures. This is accomplished through the creation of a small gastric pouch in Roux-en-Y gastric bypass surgery, through placement of an adjustable gastric band, or through the creation of a sleeve in sleeve gastrectomy surgery. In addition to inducing early satiety, it is thought that reducing the gastric reservoir capacity increases the stimulation of gastric mechanical and chemical receptors, alters gastric emptying, and modulates the level of gastric orexigenic hormones, which further contribute to weight loss [2,3]. Thus, multiple endolumenal bariatric therapies (EBT) have attempted to remodel the stomach and reduce its capacity using endoscopic suturing devices, gastric plication baskets, or endoscopic stapling [4].

Early efforts at endoscopic gastric remodeling for weight management focused on creating gastric partitioning, mimicking vertical-banded gastroplasty or Magenstrasse sleeve gastroplasty, using either a suction-based superficial suturing device that created an everted mucosa-to-mucosa plication (EndoCinch Suturing System, CR Bard, Murray Hill, NJ) or an endoscopic stapling device (TOGA; Satiety Inc, Palo Alto, CA) [5-7] (Figure 1). Results from both techniques were suboptimal as the ultimate shape of the remodeled stomach was not conducive to perturbations in neurenteric gastric pathways regulating appetite such as gastric emptying, accommodation, and the gut neurohormonal response. Furthermore, the plications were not durable as was the case with the suction-based suturing system.

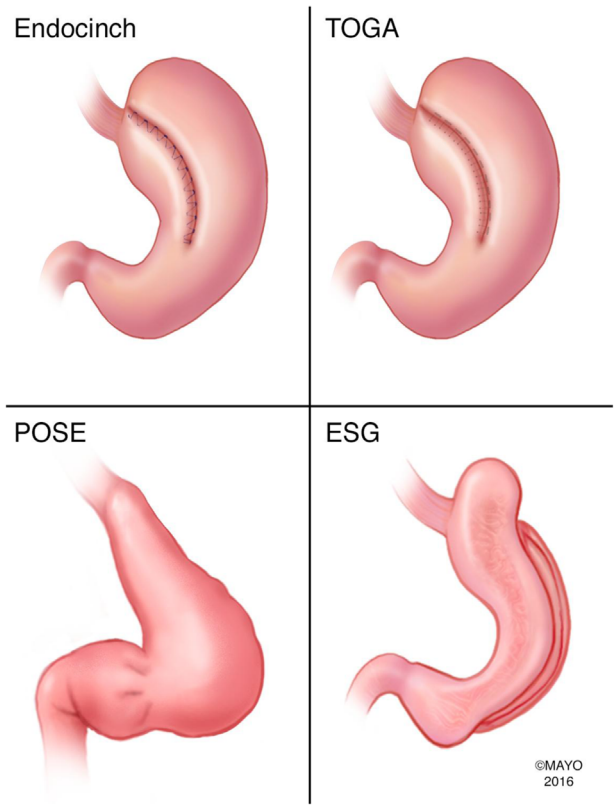

Fig. 1. Comparative appearances of earlier attempted but abandoned (EndoCinch and TOGA) and current (POSE and ESG) gastric remodeling techniques. (Color version of figure is available online.)

Preclinical work in the authors' Developmental Endoscopy Unit was initially focused on identifying optimal endoscopic gastric suturing and plication techniques and the histologic tissue response to them. Through these efforts, we realized that superficial everted (mucosa-to-mucosa apposition) intraluminal plications do not induce fusion between the joined gastric folds. Rather, full-thickness plications involving serosa-to-serosa appositions (serosal juxtaposition) afforded by full-thickness suturing or anchored suture designs, such as sutures anchored with T bar, T bar with mesh bolster, star, or basket. These result in serosal fusion and durable plication, a finding confirmed by investigations [8-10].

Two gastric remodeling procedures designed based on the above principles are currently either in clinical practice or awaiting regulatory approval. These include endoscopic sleeve gastroplasty (ESG) and Primary Obesity Surgery Endolumenal (POSE). The 2 techniques are discussed in detail in the next section.

3. Current endoscopic gastric remodeling techniques

3.1. Endoscopic sleeve gastroplasty

ESG is a transoral endoscopic gastric volume reduction technique that reduces gastric capacity by creating an endoscopic sleeve [11-20]. This is accomplished by a series of endolumenally placed full-thickness sutures through the gastric wall, extending from the

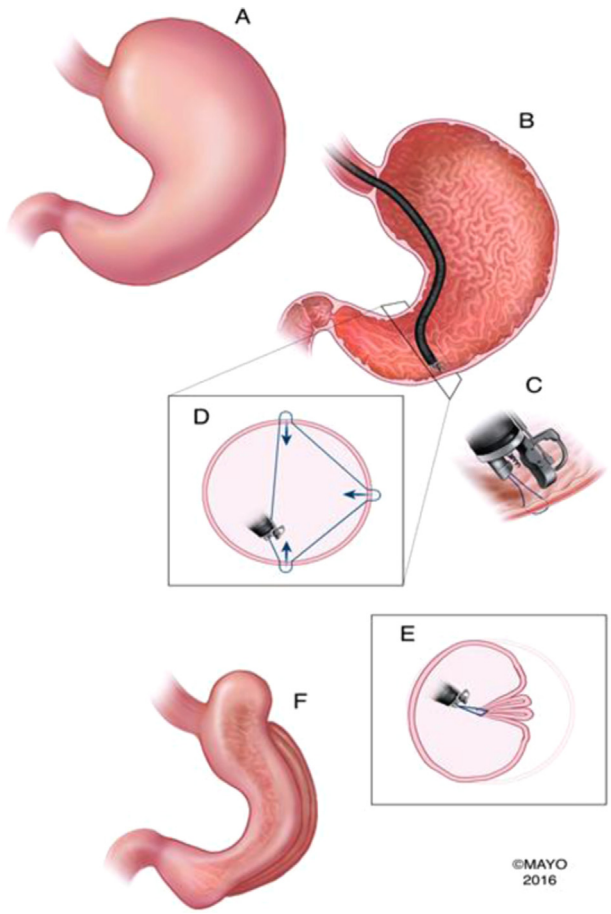

Fig. 2. Schematic representation of endoscopic sleeve gastroplasty: (A) Candidate normal stomach (B) Two-channel therapeutic endoscope used. (C) The endoscopic tip is fitted with a suturing system, which allows full-thickness stitch placement. (D) Three-stitch plication pattern (anterior, greater curve, and posterior). (E) Clinching the 3-stitched into a plication creates a large surface area for serosal fusion. (F) The completed sleeve from the antrum up into the fundus reduces gastric volume by 80%. (Color version of figure is available online.)