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Current Perspective

A perspective on metabolic surgery from a gastroenterologist

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ABSTRACT

Type 2 diabetes (T2D) and obesity are important public health problems. The global prevalence of diabetes mellitus is 8.8%. Interventional diabetology and obesitology have been recently advocated as treatment options for T2D and obesity. The roles of metabolic surgery such as Roux-en-Y gastric bypass, sleeve gastrectomy, gastric banding, and biliopancreatic diversion are focused. Different types of metabolic surgeries have different glucose-lowering and weight loss effects. Endoscopic treatments include the intra-gastric balloon (to restrict the gastric volume) and duodenal-jejunal bypass liner (DJBL, as a malabsorptive procedure). Anatomic changes in the gastrointestinal tract may cause alterations in gut hormones, bile acids, adipokines, inflammatory cytokines, hepatokines, myokines, gut microbiota, and even unidentified factors. Modulating gut hormones, including foregut (ghrelin, glucose-dependent insulinotropic polypeptide) and hindgut (glucagon-like peptide-1, peptide YY) hormones, through metabolic surgeries improves glycemic homeostasis. Metabolic surgeries reduce pro-inflammatory cytokines and increase anti-inflammatory cytokines. Metabolic surgeries also regulate one's appetite through the new establishment of jejunal nutrient sensing. Therefore, the effects of metabolic surgery and DJBL implantation emphasize the crucial role of the small intestine in glucose homeostasis. Removing diabetogenic or obesogenic factors from the duodenum and/or jejunum may help to solve the problems of diabetes and obesity in the future.

1. Introduction

Type 2 diabetes (T2D) and obesity are the most important public health problems facing the world today, and they are the primary causes of mortality, morbidity, disability, and discrimination in human health care, education, and employment. According to the International Diabetes Federation, the global prevalence of diabetes mellitus was 8.8% in 2015, affecting more than 415 million people worldwide and almost 153 million people in the Western Pacific region (1). However, the effects of traditional treatment for T2D and obesity, including lifestyle modification and medications, are limited. Among treatment for T2D, lifestyle modification still plays a key role, although it is not more effective and sustainable than medications. Only about 14.6% of lifestyle intervention participants had partial or complete remission within the first year, and 3.4% had partial or complete remission after 4 years according to Gregg et al.'s study (2). Therefore, interventional diabetology and obesitology have been recently advocated as treatment options for T2D and obesity (3). Between these treatment options, metabolic surgery is the only effective and long-lasting way to remit T2D and lose excessive body weight (4). More evidence has shown that alteration of the gastrointestinal tract anatomy changes the intrinsic regulatory mechanism of glucose homeostasis (5). Therefore, we have written the current perspectives article from the viewpoint of a gastroenterologist to address the emerging importance of interventional diabetology in remitting human T2D.

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2. Roles of metabolic surgery

Metabolic surgery and other interventional diabetology includes several types such as Roux-en-Y gastric bypass (RYGB, Fig. 1A), sleeve gastrectomy (SG, Fig. 1B), gastric banding (Fig. 1C), biliopancreatic diversion (BPD, Fig. 1D), intra-gastric balloon (IGB, Fig. 1E), and duodenal-jejunal bypass liner (DJBL, Fig. 1F). The types of surgery are divided into malabsorptive procedures, restrictive volume procedures, and mixed procedures. Different types of metabolic surgeries have different glucose-lowering effects, according to several studies (6–8). A meta-analysis showed different efficacies of T2D remission in patients who underwent BPD (95.1%), RYGB (80.3%), and gastric banding (56.7%) (9). In our previous randomized, controlled trial, we also found greater T2D remission in patients who underwent single anastomosis gastric bypass (GB) than those who underwent SG at 12 months (93%), 2 years (81%), and 5 years postoperatively (60%) (3–5). More collective data suggest that malabsorptive type bariatric procedures that bypass the foregut, especially the duodenum (e.g., GB), seem to play a better role in diabetes remission and weight loss than only procedures that restrict gastric volume. However, surgery that restricts gastric volume still plays a role in T2D. In a 17-year retrospective study, surgery that restricted gastric volume such as gastric banding was associated with reduced mortality in diabetic and non-diabetic patients, as well as a decreased incidence of diabetes and cardiovascular diseases (10). Metabolic surgery permanently resets strong counter-regulatory responses such as hunger and cravings by re-sensitizing homeostatic regulatory circuits in the hypothalamus and hedonic-motivational processing in cortico-limbic systems through changes in gut-brain signaling, leading to differential nutrient handling and energy partition postoperatively (11).

In addition, treatment methods that use endoscopy to restrict the gastric volume such as IGB or as malabsorptive procedures such as DJBL emerge. The IGB procedure was first used in 1985 for

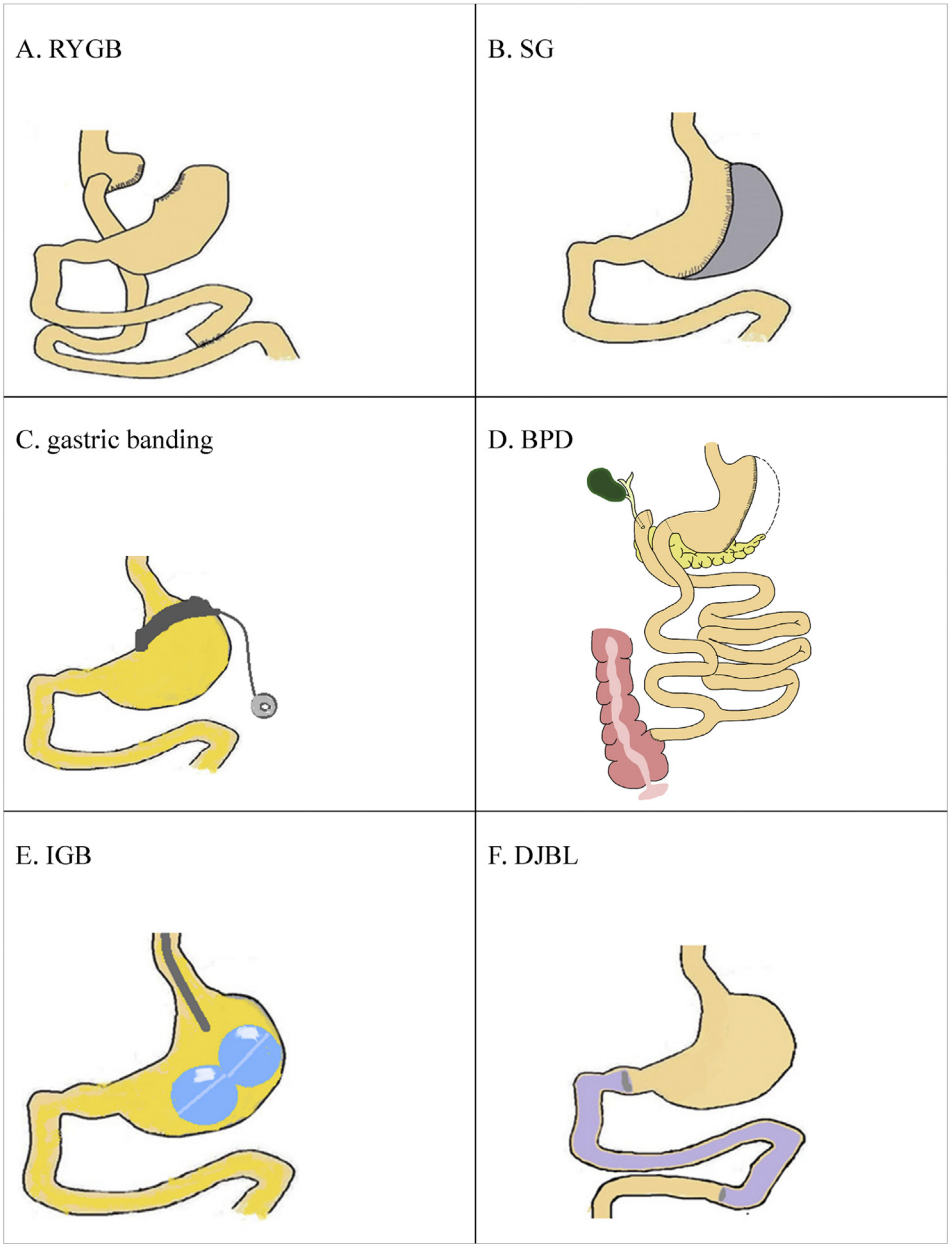

Fig. 1. Diagrams illustrating different surgical and interventional medical treatment for type 2 diabetes in humans: (A) Roux-en-Y gastric bypass (RYGB), (B) sleeve gastrectomy (SG), (C) gastric banding, (D) biliopancreatic diversion (BPD), (E) intra-gastric balloon (IGB), and (F) duodenal-jejunal bypass liner (DJBL).

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