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Indication of Bariatric Surgery (Roux-en-Y Gastric Bypass and Vertical Gastrectomy Surgery) in The Older Individuals and implications For Gut Microbiota

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Abstract

The prevalence of obese older individuals with multi morbidity has increased in developing countries. The indication of bariatric surgery in this group, such as Roux-en-Y Gastric Bypass Surgery (RYGB) and vertical gastrectomy (VG), is the focus of intense debate and controversy, mainly due to the nutritional and microbiota alterations it provokes. Within this context, this mini review aims to discuss the indication of bariatric surgery in the older individuals and its impact on intestinal microbiota.

Keywords: Bariatric Surgery; Gastric Bypass; Gastrectomy; Aging, Microbiota

Introduction

Life expectancy and the obesity epidemic have considerably increased in different regions of the world, especially in developing countries. Various strategies exist for the treatment of obesity, although diet therapy, physical activity and lifestyle modification programs form the pillars of this treatment [1]. However, if these strategies fail to treat obesity and its comorbidities, combination with pharmacological therapy becomes necessary, and as a last resort, bariatric surgery should be indicated. Obesity is considered a risk factor that reduces quality of life and life expectancy, and bariatric/metabolic surgery has been found the most effective treatment for morbid obesity [2]. The efficacy of bariatric procedures in inducing and maintaining weight loss is, for the most part, superior to that achieved by drug therapies or lifestyle modification [2]. Surgery results in greater weight loss and improvement in weight-related comorbidities in comparison to non-surgical interventions, regardless of the type of procedure adopted [2, 3]. Nonetheless, the indication of bariatric surgery in people aged over 65 years is still controversial and subject to discussion, and should be considered very carefully, although studies have shown that individuals older than 55 years are comparable to bariatric patients in the general population [4, 5]. Caution should taken as the elderly present alterations of the gastrointestinal tract and microbiota that are inherent to the aging process, such gastric mucosa atrophy, causing lower production of hydrochloric acid and decreased absorption of vitamin B12, as well as reduced peristalsis, intestinal constipation and dysbiosis [1]. The indication of a combination (restrictive and malabsorptive) bariatric technique, such as a Roux-en-Y Gastric Bypass Surgery (RYGB) and Duodenal Switch ("Scopinaro") in the older individuals can be risky, not just in terms of nutritional needs, but primarily for promoting modifications in the intestinal microbiota. In the case to minimize malabsorption, the vertical gastrectomy for obese older individual seems to be the best choice. In this context, it is important to highlight the frequent use of polypharmacy in the elderly, whether obese or not, which alters gastric pH and makes the use of gastro protective drugs necessary. It is also common after bariatric surgery to recommend the use of gastro protectors and these can cause problems with adequate absorption of micronutrients, such as iron and B-complex vitamins, which may endanger microbiota and consequently lead to nutritional risk in the elderly. In this context, this mini-review aimed to discuss the indication of the RYGB and vertical gastrectomia in older people and impact on gut microbiota, because this subject is extremely recent and in intense debate.

Impact of RYGB and vertical gastrectomy on intestinal microbiota: health implications for the elderly

In RYGB [6], the exclusion of food passage through a long

section of small intestine stimulates bile to reach the most distal intestine, as released bile is not mixed with ingested food. In this sense, weight loss, amelioration of comorbidities such as DM2, alteration of the secretion and action of some peptides and intestinal hormones, as well as the increased concentration of circulating bile acid are the result of these changes. RYGB modifies the intestinal microbiota, with an increase in gamma proteobacteria being observed, to the detriment of *Firmicutes, Clostridia* and Verrucomicrobia [7]. A bacterial overgrowth after RYGB can also be verified in the bypassed stomach and proximal gastric pouch, as well as an increase in pH in the proximal stomach and alteration in the microbial composition of the distal intestine, when compared with an obese and eutrophic group [8]. In addition, several alterations are found in the rerouted small intestine, such as, for example, decreased jejunal mucosal surface area and decreased paracellular permeability. These changes could contribute to a reduction in absorption of luminal microbiota-derived inflammatory mediators, such as endotoxins [9].

Research conducted by Furet et al. [10], comparing the intestinal microbiota of obese individuals submitted to RYGB (pre-surgery=basal, 3 and 6 months post-surgery) against lean individuals, found the *Bacteroides/Prevotella* group to be lower in obese individuals than in the controls pre-surgery, and increased in the obese group at 3 months postoperatively. It was negatively correlated with body corpulence, but the correlation was highly dependent on caloric intake. The results also showed the *Escherichia coli* species increased after 3 months post-surgery and were inversely correlated with fat mass and leptin levels, independent of changes in dietary intake. Conversely, the *Lactobacillus/Leuconostoc/Pediococcus* group and *Bifidobacterium* genus decreased after three months post-surgery. Lastly, the *Faecalibacterium prausnitzii* species were reduced in the obese individuals with diabetes and negatively associated with inflammatory markers pre-surgery, and throughout the follow-up period, regardless of changes in food intake. These results suggest that intestinal microbiota adapt rapidly to the situation of caloric restriction induced by RYGB, whereas the *F. prausnitzii* species are directly linked to a reduction in the low-grade inflammation state in obesity and diabetes, regardless of calorie intake [10].

Investigation of the effects of RYGB on the metagenome of intestinal microbiota in obese diabetic individuals demonstrated this procedure causes alterations in 11 genera and 22 species of bacteria. Moreover, a change towards increased proteobacteria was observed, in particular *E. cancerogenus, S. boydii* and *S. enterica,* as well as a decline in butyrate formation produced by Firmicutes, such as *F. prausnitzii, C. comes and A. caccae,* induced by RYGB. These results may have long-term harmful effects on host health, with the potential risk of intestinal inflammation and colorectal carcinomas [11]. For this reason, the indication of RYGB in the elderly needs careful thought and a full evaluation of the risks and benefits of the surgery, especially as the results of research remain controversial.

In VG, 80% of the stomach is removed, including longitudinal resection of the fundus, body and antrum, but without alteration of the pylorus. A tubular duct is created following the smaller curvature, leaving around a 100 ml volume. The procedure resembles RYGB in terms of weight loss and improved carbohydrate metabolism, causing rapid gastric emptying and accelerated intestinal transit. Some authors report VG as being safe for use in the older individuals and with reduced risk of malabsorption that occurs in RYBG. This technique, VG, however, also leads to bile acid alterations in the intestinal microbiota and causes loss of energy-rich fecal substrates [12]. Following RYGB, bile acids secreted in the duodenum do not mix with food until the two arms of the RYGB unite to form a common channel in the distal jejunum. This surgical alteration changes the composition and levels of bile acids in different compartments, including general circulation, independently of weight, a similar situation as occurs in GV (increased bile acids) [13].

Intestinal microbiota differs in the microbial community structure, genetic content and metabolic network organization between obese and lean individuals [14]. Diets with different fat and sugar content compositions may also affect microbiotic structure [15], favoring the growth of bacteria with secreted components and factors that contribute to the development of adiposity, insulin resistance and other metabolic disorders.

Each organism has its own microbiota. This includes human holobiont, a conglomerate of human and multispecies microbial cells in spatially segregated ecosystems, whose content is influenced by topography and biologic individuality [16]. Diet and aging are important markers of this biologic individuality. Aging determines specific changes in the intestinal microbiome, such as increased proteolytic and decreased saccharolytic bacteria, which are associated with sarcopenia and longevity [17]. Diet, in turn, has shown to be an important regulator of microbiota structure and function, both in the short- and long-term [18], while alterations in diet have been seen to rapidly affect the composition of microbiota [19]. Older people people tend to have little variation in diet [20], where preference is given to processed products, fats and simple carbohydrates rather than unprocessed products, complex carbohydrates, fruits, legumes and vegetables. These habits compromise the beneficial actions of food on the intestinal microbiota [21]. Short-chain fatty acids, which are generated by the microbial fermentation of dietary polysaccharides in the intestine, are an important source of energy for colonocytes and also function as signaling molecules, modulating intestinal inflammation and the metabolism [22]. The consumption of proteins and amino acids, which at times are insufficient in the diet of the elderly [23], represent access to important substrates for colonic microbial fermentation [24], where they also serve as a significant source of nitrogen to support the growth of microbiota.

Conclusion

In summary, all these aspects need prior consideration in older patients who are candidates for bariatric surgery. In

particular, the risks/benefits of bariatric surgery in people older than 65 years need to be quantified within an ecosystem-based context. Evidence has shown that modifications in the intestinal microbiota induced by RYGB and VG contributes to the reduction of weight and adipose tissue in the host, however, there is considerable change in the genera colonizing the intestine, which can trigger inflammatory and carcinogenic processes in the long term [11]. On the other hand, a diet rich in probiotics may aid in the restoration of beneficial microbiota and overall health of the elderly.

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