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Mini Review

Bariatric Surgery Remodels Gut Microbiota

Yuanjun Zeng[1], Yunxiang Tan[1] and Deng Lin[2,3,4]*

[1]Faculty of Ecology and Environment, Hainan University, China

[2]School of Life Sciences, Fudan University, China

[3]Greater Bay Area Institute of Precision Medicine, China

[4]Beijing Research Center for Chinese Classic Science and Technology, China

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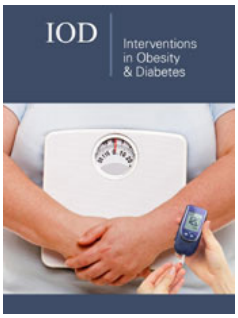

***Corresponding authors:** Deng Lin, School of Life Sciences, Fudan University, Greater Bay Area Institute of Precision Medicine, Beijing Research Center for Chinese Classic Science and Technology, 102425, Peking, China

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Abstract

Obesity, as a chronic disease influenced by multiple factors, has been steadily increasing worldwide in recent years. Researchers have started to investigate the relationship between gut microbiota and obesity, and significant differences have been observed between the gut microbiota of obese patients and that of healthy individuals. These differences primarily involve an increase of Phylum Firmicutes and the decrease of Phylum Bacteroidetes, among others. Individuals with severe obesity often choose bariatric surgery as a means of achieving weight loss. Studies have shown that bariatric surgery can alter the composition of the gut microbiota, thereby impacting the host's body weight. However, the specific effects of different types of surgeries on the gut microbiota composition vary.

Keywords: Bariatric surgery; Gut microbiota; Obesity

Introduction

Obesity is a major public health concern worldwide [1], with the global adult obesity rate increasing rapidly, as indicated by the 2016 report from the World Health Organization. The report revealed a significant rise in the global adult obesity rate from 8.7% in 2000 to 13.1% in 2016. The development of obesity is closely linked to the composition of gut microbiota, and this connection is strongly supported by observed differences in gut microbiota between obese and non-obese mice [2]. For patients with severe obesity, traditional methods of weight loss are often ineffective, making bariatric surgery the most viable option for achieving a healthy weight [3].

Differences in Gut Microbiota between Obese and Healthy Individuals

For the study of gut microbiota differences between obese and non-obese individuals, by assessing the gut microbiome composition of obese and non-obese adults using high-throughput sequencing, it was found that obese individuals had lower gut microbial diversity and compositional differences at the phylum and genus levels. Specifically, obese individuals had significantly more Phylum Firmicutes and fewer Phylum Bacteroidetes of gut microbiota [4], at the genus level, obese individuals had lower relative proportions of *Bifidobacterium* and *Eggerthella* and higher relative proportions of *Acidaminococcus*, *Anaerococcus* and *Catenibacterium* compared to non-obese individuals [5]. However, there is heterogeneity among the study populations in different studies, e.g., the composition of the gut microbiota in different populations is influenced by geographic factors, dietary status, and exercise training [6], e.g., the American community, the Japanese and Korean communities, and the Chinese community show differences in the high abundance of gut microbiota in different populations. These differences can be observed at the genus level, with Japanese showing high abundance of *Bifidobacterium* and *Clostridium* in their gut microbiota, Chinese showing high abundance of Bacteroides and Koreans showing high abundance of *Prevotella* and *Faecalibacterium* [7]. Thus, there is no clear answer to the difference in gut microbiota between obese and non-obese individuals.

Effects of Different Bariatric Surgeries on the Gut Microbiota

The major bariatric surgeries available include sleeve gastrectomy [8], Gastric Banding Surgery and Roux-en-Y gastric bypass surgery. These surgeries effectively modify the structure and function of the digestive system, thereby impacting the composition of the gut microbiota [9]. Patients undergoing different surgical procedures may experience varying outcomes in terms of changes to their gut microbiota. A study comparing three obese individuals, three lean individuals, and three individuals undergoing Roux-en-Y gastric bypass surgery revealed significant changes in the gut microbiota composition. Following the surgery, there was an increase in the proportion of Gamma proteobacteria, primarily represented by *Enterobacteriacee* and *Fusobacteriaceae*, alongside a decrease in the levels of Firmicutes (namely *Clostridium* bacteria) and methanogens. Based on these findings, it can be hypothesized that Roux-en-Y gastric bypass surgery in the small intestine may lead to the migration of specific bacteria (e.g., *Enterobacteriaceae*) to the large intestine. This shift in microbial distribution alters the microenvironment of the intestine, subsequently affecting food intake and digestion [10], When the gut microbiota from mice that underwent Roux-en-Y gastric bypass surgery was transferred to germ-free mice that had not undergone the surgery, the recipients experienced weight loss and a decrease in fat mass.

However, these changes were not observed in mice that received microbiota from recipients of sham surgery. These findings provide additional evidence for the connection between alterations in the gut microbiome following Roux-en-Y gastric bypass surgery and the reduction of weight and obesity in the host [11]. In addition, research studies have demonstrated that sleeve gastrectomy and adjustable gastric banding procedures are effective in reducing the presence of Bacteroides spp. and leading to a decrease in archaeal faecal counts and concentrations of short-chain fatty acids. Roux-en-Y gastric bypass surgery has also been found to bring about changes in the microbial composition, including decrease in *Firmicutes* to Bacteroidetes ratio, and an increase in Proteobacteria [10]. These alterations in the microbiota have been significantly associated with improved weight control, metabolism, and inflammatory parameters. However, it is worth noting that there may be a potential risk of intestinal inflammation and the development of colorectal cancer associated with these changes [11].

Future Prospects

Although the impact of bariatric surgery on gut flora has been demonstrated, the precise mechanism of action remains incompletely understood [12]. Alterations in gut microbiota may either occur as a concurrent event to bariatric surgery or contribute to metabolic improvements. Consequently, additional research is necessary to elucidate the specific changes in various flora following bariatric surgery and to obtain a more comprehensive comprehension of how gut flora influences metabolism after bariatric surgery.

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