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The role of bariatric surgery in the treatment of type 2 diabetes in morbidly obese patients

Abstract

Obesity is a worldwide chronic epidemic and is a strong predictor of mortality. Its prevalence continues to increase despite public health efforts of awareness. With the rise in obesity and specifically morbid obesity worldwide, there has been a pronounced increase in obesity related metabolic disorders such as type 2 diabetes mellitus, hyperlipidemia, hypertension and some others. Reduction in weight is very important to control diabetes and one of the only measures that may cure diabetes and reduce weight loss is bariatric surgery. Bariatric surgery results in weight loss and the resolution of diabetes. Studies have shown that the effect of surgical weight loss has a more pronounced effect that diet controlled weight loss. This occurs due to several metabolic changes that occur in the body. The levels of incretins significantly rise including the rise of glucagon like peptide-1 and glucose-dependent insulinotropic polypeptide. In addition, PYY 3-36 and oxyntomodulin also rise post-surgery. On the other hand, there are reductions in branched chain amino acids, aromatic amino-acids phenylalanine and tyrosine.

Keywords: diabetes, bariatric surgery, gastric bypass, obesity, insulin, in cretins, amino-acids, BCAA, BMI, dm

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Abbreviations: BCAA, branched chain amino acids; BMI, body mass index; DM, diabetes mellitus; GBP, gastric bypass; GLP-1, glucagon like peptide-1 rise; GIP, glucose-dependent insulinotropic polypeptide; OGTT, oral glucose tolerance test; PHE, phenylalanine; TYR, tyrosine

Introduction

The increase in the worldwide obesity prevalence is associated with a rise in its comorbidities such as type 2 diabetes, hyperlipidemia, hypertension, obstructive sleep apnea, heart disease, stroke, asthma, etc).[1,2] Diabetes has always been a chronic disease and among the most common non communicable diseases affecting people worldwide. In the early nineties, Dr. Walter Pories discovered that diabetes is curable.[3] This discovery was found after performing weight-loss surgery (also known as bariatric surgery) on morbidly obese patients suffering from diabetes. It was not until 1995 where he published his findings on an operation that cures adult onset diabetes mellitus (DM) (Type 2 DM).[3] In 2011, the American Diabetes Association published the standards of medical care in diabetes where bariatric surgery was considered when adults have a body mass index (BMI) >35kg/m^2 and type 2 DM, especially if the diabetes or associated comorbidities are difficult to control with lifestyle and pharmacologic therapy.[4]

In addition, the International Diabetes Federation announced their support of having bariatric surgery to treat type 2 diabetes in obese patients.[5] Since 2011, more randomized controlled trials were conducted and they showed that most obese patients were cured from type 2 diabetes after their bariatric surgery.[6,7] The most common forms of bariatric surgery include gastric banding (including adjustable and non adjustable bands), gastric bypass (Roux-en-Y gastric bypass), biliopancreatic diversion (duodenal switch) and gastric sleeve (gastroplasty).[8,9] There is loss of life expectancy attributed to obesity. By comparing a normal weight Caucasian individual to a 25year old morbidly obese man, there is a 22% reduction in the expected remaining life span, representing an approximate loss of 12years of life of the morbidly obese man.[10]

Gastric bypass (GBP) being the most commonly performed bariatric surgery involved creating a small gastric pouch (30 cc.) that is directly anastomosed to the distal part of jejunum. The biliopancreatic limb (pylorus, duodenum, remaining part of jejunum) are then shunted from nutrients and restructured to the ileum allowing gastrointestinal and pancreatic juice to be mixed with nutrients in the distal intestine.[11]

Discussion

Studies have shown that post-surgery, the average levels of HbA1c are lowered and the clinical outcomes of comorbidities are much better than conventional and intensive medical therapy for obese diabetic patients.[9] There was also a significant decrease in insulin levels and fasting blood glucose postoperatively.[10] According a recent study, having bariatric surgery being done in addition to intensive medical therapy for the treatment of type 2 diabetes in patients with BMI 27-43, yielded significant results in the reduction and sometimes resolving of diabetes compared to intensive medical therapy alone.[12] Another recent study showed that the risk of microvascular complications is reduced due to improved glycemic control in pre diabetic patients who undergo bariatric surgery.[13]

Diabetes resolves after bariatric surgery due to several reasons. It commences by post-surgery massive weight loss. Some studies showed than the surgical control of diabetes results from the rearrangement that takes place in the gastrointestinal anatomy. Reduction in the inflammatory mediators improves adipokines which occurs due to the reduction of the fact content in adipocytes. This eventually affects insulin sensitivity regulation. The loss of the fat mass and reduction in inflammatory mediators are associated with increased insulin sensitivity and glucose disposal, reduced free fatty acid flux, decreased interleukin 6, tumor necrosis alpha and high C-reactive protein levels. Gastric bypass leads to metabolic changes such as altered responses of ghrelin, glucagon like peptide-1 rise (GLP-1), oxyntomodulin rise released by the L cells and peptide (YY3-36) which contribute to glucose regulation and appetite control.[8,11,14]

Bariatric surgery and more specifically GBP results in a change in

the levels of incretins such as the glucose-dependent insulinotropic polypeptide (GIP) and the (GLP-1).[15,16] These are gastrointestinal hormones secreted from the duodenal K cells and ileal L cells respectively and they are responsible for around 50% postprandial insulin secretion.[17,18] Studies and reports have shown that 5-20years after GBP, there was a significant rise in the GLP-1 and GIP postprandial levels compared to non-operated individuals.[11,19,20] Incretin level and effect, early phase insulin release during the Oral Glucose Tolerance Test (OGTT) and the insulinogenic index all are corrected promptly after GBP, while fasting glucose, fasting insulin, leptin or adiponectin improve due to weight loss in the first year post GBP.[21]

In addition to the increase in incretins, adiponectin and leptin decrease due to weight loss after GBP, beta cell function improves and abnormally elevated proinsulin and amylin levels decrease in diabetic patients.[21] Moreover, more studies have shown changes in amino-acid metabolism after GBP. There has been a significant reduction in branched-chain amino-acids (BCAA), aromatic amino-acids of phenylalanine (Phe) and Tyrosine (Tyr) after GBP and this was associated with improvement in glycemic control and more improvement in insulin secretion.[22–24] These metabolites are closely related to insulin resistance and diabetes and can lead to metabolic dysfunction but they are also very responsive to weight loss induced by surgery. BCAA can even predict the risk of type 2 DM.[25] After bariatric surgery, there is also changes in the eating rate, gastric emptying, nutrient absorption and sensing, microbiota and the metabolism of bile acids which all play a role in the resolution of diabetes, but some relapses in diabetes have also been noted.[11]

Conclusion

The main objective behind considering bariatric surgery is for weight loss which eventually leads to the resolution of diabetes. This can be done when the benefits of having the surgery outweigh its risks and after having adequate consultations with the dietitians, psychiatrists or psychological specialists and bariatric surgeons. The surgery is not entirely safe and as other surgeries, it carries risks of complications. Careful screening and adequate follow-up is very important after the surgery. The data present in the literature show that bariatric surgery is a useful procedure for weight loss and the treatment of type 2diabetes. Recently identified links of bariatric surgery and diabetes including the reductions in amino acids increase in incretins, opens new dimensions in the evaluation and treatment of diabetes. It is important to understand in depth the mechanism behind such change in metabolism in order to develop new surgical and medical tools to prevent the recurrence of diabetes after surgery.

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Conflict of interest

Author declares that there is no conflict of interest.

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