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The Effectiveness of Roux-en-Y Bariatric Surgery Technique on Weight Loss and Diabetic Medication Reduction in Type 2 Morbidly Obese Adults Compared to Other Methods

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Abstract
Background: Morbidly obese individuals carry with them the burden of possibly developing related conditions including hypertension, Type 2 Diabetes, stroke, sleep apnea, and myocardial infarction. Obesity has become a serious and life changing condition that has long term complications and consequences if left untreated. Roux-en-Y gastric bypass surgery has become the most widely used method in the treatment of morbid obesity and control of Type 2 Diabetes.

Hypothesis: Roux-en-Y gastric bypass surgery provides a more effective approach to morbid obesity and Type 2 Diabetes.

Study Design: Exhaustive search of available medical literature.


Results: The studies reviewed confirmed that Roux-en-Y gastric bypass provides significant improvement in weight loss and modification of Type 2 Diabetes.

Conclusion: When factors such as Type 2 Diabetes secondary to or contributing to morbid obesity, Roux-en-Y gastric bypass surgery should be a strong consideration.

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Keywords
NIDDM, insulin resistance, Roux-en-Y gastric bypass, morbid obesity

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The Effectiveness of Roux-en-Y Bariatric Surgery Technique on Weight Loss and Diabetic Medication Reduction in Type 2 Morbidly Obese Adults Compared to Other Methods

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School of Physician Assistant Studies

Pacific University

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Faculty Advisor: Dr. Mark Pedemonte
Clinical Graduate Project Coordinators: Rob Rosenow PharmD, OD & Annjanette Sommers MS, PAC
Biography

Audrea R. Williams began working in healthcare soon after completion of her undergraduate degree. Before beginning her graduate studies at Pacific University, she worked in the Bone Marrow Transplant/Leukemia Protective Environment unit at MD Anderson Cancer Center and as a Cytogenetic Technologist for Dynagene/Labcorp in Houston, Texas.
Abstract

**Background:** Morbidly obese individuals carry with them the burden of possibly developing related conditions including hypertension, Type 2 Diabetes, stroke, sleep apnea, and myocardial infarction. Obesity has become a serious and life changing condition that has long term complications and consequences if left untreated. Roux-en-Y gastric bypass surgery has become the most widely used method in the treatment of morbid obesity and control of Type 2 Diabetes.

**Hypothesis:** Roux-en-Y gastric bypass surgery provides a more effective approach to morbid obesity and Type 2 Diabetes.

**Study Design:** Exhaustive search of available medical literature

**Methods:** Literature search of CINAHL, PubMed, Ovid, Google Scholar, EJournals and search terms Roux-en-y, bariatric surgery, diabetes, surgery for obesity

**Results:** The studies reviewed confirmed that Roux-en-Y gastric bypass provides significant improvement in weight loss and modification of Type 2 Diabetes.

**Conclusion:** When factors such as Type 2 Diabetes secondary to or contributing to morbid obesity, Roux-en-Y gastric bypass surgery should be a strong consideration

**Keywords:** NIDDM, insulin resistance, Roux-en-Y gastric bypass, morbid obesity
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List of Abbreviations

NIDDM………………………………………………Non-Insulin Dependent Diabetes Mellitus

BMI..................................................................................................Body Mass Index

RYGB………………………………………………………………Roux-en-Y Gastric Bypass

LRYGBP………………………………………………laparoscopic Roux-en-Y gastric bypass

LMGBP……………………………………………………….laparoscopic mini-gastric bypass

GBP……………………………………………………………….gastric bypass

VBG……………………………………………………………vertical banded gastroplasty

MetS…………………………………………………………….Metabolic Syndrome
The Effectiveness of Roux-en-Y Bariatric Surgery Technique on Weight Loss and Diabetic Medication Reduction in Type 2 Morbidly Obese Adults Compared to Other Methods

Introduction

According to MedicineNet.com, obesity is defined as “the state of being well above one’s normal weight”.¹ The site concedes that “traditionally” an individual’s obesity has been based on a greater than 20 percent increase above their ideal weight with height, age, sex, and build considered. Moreover, BMI (body mass index), is also an important factor to consider with obesity. This index relates a person’s body weight to their height, calculated by dividing a person’s weight in kilograms by their height in meters squared. This equation establishes total body fat content in adults. The National Institutes of Health more specifically define obesity as having a BMI of 30 and above.¹

The turn of the century has seen a significant rise in the weight of American adults. Obesity in America has become not only a serious medical condition but one of the most widespread chronic medical conditions. Data from the National Health and Nutrition Examination Survey (2001-2004) report that one third of adults in the United States are obese. A cause for alarm stems from the fact that obesity is directly related to Non-Insulin Dependent Diabetes (NIDDM), also known as Type 2 Diabetes. NIDDM causes nephropathy, retinopathy, neuropathy, and atherosclerosis. Approximately 80% of patients with NIDDM are obese.⁸ NIDDM is characterized by initial insulin resistance. Insulin is a hormone produced by the liver. It is required for the transport of blood glucose into muscle cells and fat cells to be used for energy. The act of transporting glucose into the cells allows insulin to keep blood glucose levels within a normal range. Insulin resistance occurs when glucose is no longer transported
into cells by insulin. Fat cells tend to be more insulin resistant than muscle cells, hence, the significant role obesity plays in insulin resistance and Type 2 Diabetes.\textsuperscript{3,4,5} Initially, when the pancreas detects insulin resistance, it produces more insulin. Blood glucose levels can remain normal, as long as there is enough insulin to compensate for the resistance. Type 2 Diabetes arises when the pancreas can no longer produce high levels of insulin which results in a rise in blood glucose levels. As the degree and duration of obesity increases, so does the risk of Type 2 Diabetes.

The safest and most effective way to treat morbidly obese individuals with Type 2 Diabetes has been debated for years among physicians, scientists, and researchers. The studies propose, as bariatric surgery evolves, surgeons and physicians have begun to see less surgical complication and positive results in weight loss and amelioration in comorbid conditions including Type 2 Diabetes. Dr. Walter J. Pories of the East Carolina University School of Medicine discovered the ineffectiveness of diets in over half (55.9\%) of the morbidly obese group of patients with indicators of abnormal glucose metabolism. He reported the general course of the individuals was a pattern of continuous, increased weight, worsening diabetes, and ongoing development of diabetic complications.\textsuperscript{9}

Studies published in \textit{Diabetic Care} concede that, “eleven to 36 percent of patients with NIDDM no longer respond well to diet and sulfonylurea therapy after one year of treatment. Usually, they are then treated with insulin, which induces hyperinsulinemia and possibly the development of atherosclerosis. These possibilities have led to the view that neither insulin alone nor combined treatment with insulin and sulfonylurea is satisfactory”.\textsuperscript{10,11} Years later, Dr. Pories reported that, NIDDM patients rarely return to long-term normal blood glucose concentration using a common therapy of insulin, diet, exercise, behavior modification, and oral medication. Also, the complications of diabetes, including stroke, myocardial infarction,
loss of vision, renal failure, limb amputation, and neuropathies, are not reduced.

In 1967, the first open Roux-en-Y gastric bypass surgery (RYGB) was performed by Dr. Mason and Dr. Ito as treatment for obesity. Initially, the idea of gastric bypass originated from weight loss observed in patients undergoing partial stomach removal for ulcers. Dr. Alan Wittgrove and Dr. Wesley Clark of the Center for Surgical Weight Control first developed the laparoscopic gastric bypass technique in 1993. The surgeons developed this technique to minimize incision infections and late incisional hernia that arise postoperatively, in a small percentage of patients who undergo open Roux-en-Y surgery. To avoid bile reflux, the operation was modified using a “Roux-en-Y” limb of the intestine, connected to a 20mm pouch of the stomach. As a result, the remaining stomach portion and first segment of small intestine are bypassed. In 2001, the mini-gastric bypass was introduced as a simpler procedure that allowed for shorter hospital stay post-surgery. Likewise, it is an effective weight loss treatment for morbidly obese patients and an intervention against related metabolic complications. For this reason, as well as due to minimal post-surgical side effects, Roux-en-Y gastric bypass has been found to be the gold standard procedure over the gastric banding technique and nonsurgical weight loss methods in several studies including those incorporated in this review.

Methods

Published randomized and prospective trials on morbidly obese adults with comorbidities (hypertension, hyperlipidemia, cardiovascular disease, sleep apnea, NIDDM) and the effects on these comorbidities, specifically NIDDM were included. Studies evaluating safety and efficacy comparisons of Roux-en-Y bypass surgery with other bariatric surgeries were included. Most studies were published in North America; however, studies from Sweden and Taiwan (translated into English), were also included. Although laboratory values were stated in some of the articles, the values were excluded, however, relevant information from these articles pertaining to specific surgeries and comorbidities were included. Articles on pediatric or adolescent diabetes and/or surgeries
were excluded. Articles that did not include diabetes as a comorbidity were excluded. There were articles on superobesity and RYGB that were considered. These articles did not have significant information on the superobese and NIDDM. Therefore, these articles were excluded.

**Results**

Kenneth G. MacDonald, Jr, MD et al at East Carolina University School of Medicine, compared a RYGB/NIDDM/morbidly obese group with a non-RYGB/NIDDM/morbidly obese group (control) between 1979 and 1994. The size of the control group (78 patients) treated with oral hypoglycemics or insulin for their NIDDM, increased from 56.4% to 87.5% from initial contact to last contact. The individuals in the surgical group (127 patients) needing medical management of their diabetes decreased from 31.8% post-surgical to 8.6% from at the last time of contact.4

Harvey J. Sugerman, MD et al at the Medical College of Virginia conducted a trial in which morbidly obese patients underwent conversion to GBP after complications of VBG (43 patients) or failure to lose weight after VBG surgery (15 patients). At one year follow-up after the conversion surgery, the percentage of excess weight loss among the 53 patients was 36% +/- 24% to 76% +/- 18%. In patients who could be contacted over a period of eight years, weight loss was continual.5

Wei-Jei Lee, MD, PhD et al at En-Chu Kong Hospital in Taiwan, conducted a trial comparing Roux-en-Y gastric bypass (LRYGBP) technique to a laparoscopic mini-gastric bypass (LMGBP) for the treatment of morbid obesity. The percentage of excess weight loss at one year was 58.7% in the LRYGBP group and 64.9% in the LMGBP group. The percentage of excess weight loss at two years was 60.0% in the LRYGBP group and 64.4% in the LMGBP group. The authors indicate that LMGBP is simpler than LRYGBP. However, they are both acceptable and effective treatments for weight loss in morbidly obese patients with metabolic syndrome (including NIDDM).3

John A. Batsis, MBBCh et al at Mayo Clinic in Rochester, MN conducted a study of patients with a body mass index of 35 or greater and metabolic syndrome components. They compared these patients,
180 had Roux-en-Y gastric bypass surgery and 157 did not have surgery. Instead, the nonsurgical group was evaluated in a weight-reduction program. Increased fasting plasma glucose was one of the components. The study considered patients to have diabetes mellitus if they were taking oral hypoglycemic medication or insulin or if they had fasting glucose level of 126 mg/dL (without a diagnosis of DM). In the surgical group, 156 out of 180 patients with MetS decreased to 36 patients and all components (including DM) of metabolic syndrome were improved with a decrease in use of medication. Of the nonsurgical group, 133 out of 157 patients with MetS decreased to 117 patients. That is an 87% decrease to 29% of patients in the surgical group and only 85% to 75% decrease in the nonsurgical group. The study concluded that 2.1 individuals needed to be treated to achieve resolution in one case of metabolic syndrome.⁶

Discussion

Indeed, the bottom line for all four studies reviewed is that the Roux-en-Y gastric bypass technique produces effective results in weight loss and a reduction in the use of hyperglycemic agents in morbidly obese patients with Type 2 Diabetes. The two studies that focused on comparing weight loss and diabetic medication management in a control and surgical group, contend that the techniques of the Roux-en-Y gastric bypass is a significant factor in weight loss.⁵,⁶ Moreover, the studies question whether baseline diabetes status play a role in the weight loss, as well as rapid reduction in comorbid conditions, including diabetes.⁵,⁶ Although the MacDonald study was unable to gather sufficient follow-up data concerning weight in the control group, investigators were able to determine medical management of diabetes.⁴ Likewise, the Mayo Clinic did not consider their study to have a “true” control group compatible with a generalized patient base attempting to lose weight using nonsurgical methods. The investigators suggest that the findings for their control group can only be applied to obese individuals with a BMI of 35–39.9 (class II) and a BMI ≥ 40 (class III), who have been evaluated for RYGB gastric bypass surgery.⁶ The challenge of forming a control group for both studies poses limitations regarding other bariatric surgeries and individuals more compatible with the
surgical subjects.

The remaining studies in this review compared the Roux-en-Y gastric bypass technique to other surgical techniques for the treatment of morbid obesity.\textsuperscript{3,5} the Taiwan study concedes that the Roux-en-Y technique is the “gold standard” based on its effect on weight loss in other randomized trials. However, the study attributes the mini-gastric bypass as having similar results in weight reduction, as well as a less intricate and safer operation.\textsuperscript{3} The Sugerman study noted a significant resolution of surgical side effects when patients were converted from the vertical banded gastroplasty to Roux-en-Y gastric bypass. The study also acknowledges the safety factor of the conversion surgery. Although investigators achieved complete weight loss follow-up results at one and two years, they were only able to accomplish a 45% follow-up at five years.

**Conclusion**

The relationship between obesity and diabetes involves high food intake. This relationship has been incredibly frustrating and disappointing for both physician and patient alike, in the treatment of weight loss as well as diabetes. Understandably, most patients are apprehensive about surgery as an option for weight loss. Moreover, there are morbidly obese patients who are not psychologically prepared for such a life altering change in their appearance and in the emotional escape that increased food intake provides them. This creates a certain amount of discouragement among patients and physician, leading to exhaustive weight loss treatments of diet and exercise for patients. Although glucose metabolism can be improved with diet modification in an obese individual, it is usually short term and fractional. As indicated in the Mayo Clinic study, the nonsurgical group had more individuals with unresolved Type 2 Diabetes and increased number were on insulin.\textsuperscript{6}

Inevitably, when the decision is made to undergo surgery, euphamistically referred to as the option of last resort, the choice most often is Roux-en-y gastric bypass over gastric banding. Although RYGB is not a cure for NIDDM, it offers a rapid, but safe return to normal glucose range before
substantial weight loss is achieved. Normal levels are observed and maintained as early as the third or fourth days post-surgery without insulin. Researchers at the Medical College of Virginia acknowledge that other surgical methods, like gastric banding, are successful treatments for weight loss only, but does not contribute directly to reducing diabetic medication use and comorbidities or contributing factors of morbid obesity although there is an indirect effect based on achieving weight loss. The technique only allows for gradual adjustment of stomach size over time. By making the stomach smaller over time, an individual feels full, thus decreasing their desire to continue to eat. The Roux-en-Y gastric bypass technique of disconnecting the duodenum (top of the small intestine) and attaching the remainder of the small intestine to a small pouch of the stomach, has been found to be a very effective way of directly causing a remittance of Type 2 Diabetes in morbidly obese patients. Researchers believe when food skips the first part of the intestinal tract, there is a change in hormonal regulation of blood sugar. This theory, as well as studies similar to the one in this review, influenced Dr. Francesco Rubino, Director of the Diabetes Surgery Center at New York-Presbyterian Hospital/Weill Cornell Medical Center. His study used rats with Type 2 Diabetes. He found that once the duodenum is reattached and food is no longer being blocked from it, the rats resume Type 2 diabetes characteristics.

Treatment for morbid obesity and Type 2 Diabetes has definitely come a long way and there is still more to discover as obesity continues to be a long term health dilemma in the United States and around the world. It is comforting to know, despite the risks involved, there are now successful options for treating obesity related Type 2 Diabetes. Perhaps similar studies involving adolescents, superobese, and specific racial groups with NIDDM would be helpful. Also, studies that focus on the relationship between specific antidiabetic medications and gastric bypass surgery would provide information to researchers, physicians, and pharmaceutical companies. Nevertheless, patients with Type 2 Diabetes should be aware of the risk and benefits of any weight loss option considered.
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Figure 1.
Roux-en-Y gastric bypass and mini-bypass illustrations\textsuperscript{13}

Figure 2.
Verticle Banded Gastroplasty illustration\textsuperscript{14}