

The Surgical Intervention for Noninsulin-Dependent Diabetes Mellitus

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Abstract: In recent years, studies show that bariatric surgery is effective for patients with morbid obesity and for those with non-insulin-dependent diabetes mellitus. We reviewed the published reports and found that gastric bypass, biliopancreatic diversion, and gastroplasty all improve blood glucose and reduce weight in morbidly obese patients with noninsulin-dependent diabetes mellitus.

Key Words: noninsulin-dependent diabetes mellitus, surgical intervention
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Noninsulin-dependent diabetes mellitus (NIDDM) is a global health problem. The International Diabetes Federation (IDF) reported in 2006 that the number of patients with diabetes worldwide had reached 214.6 million, and is anticipated to increase to 318.8 million by 2025. NIDDM is associated with increased morbidity and mortality. At present, the main therapies include insulin, diet, exercise, and oral antidiabetic drugs. In recent years, bariatric surgery has been effective in treating patients with morbid obesity and with NIDDM. We reviewed the main published reports and found that gastric bypass (GBP), biliopancreatic diversion (BPD), and gastroplasty all are effective in improving blood glucose levels and reducing weight in morbidly obese patients with NIDDM. The precise mechanism by which surgical intervention improves diabetes mellitus is unclear. Insulin recovery times in morbidly obese patients with NIDDM following surgical intervention often precede weight loss, implying that insulin recovery was not correlated with weight loss. We review the current literature and therapeutic strategies for NIDDM and suggest a possible mechanism.

Background

In 1978, Mason et al¹ reviewed the data from 625 morbidly obese patients who underwent GBP and found that this treatment was effective in controlling not only BG levels in patients with NIDDM, but also a number of other comorbidities of obesity, including hypertension, sleep apnea, cardiopulmonary failure, arthritis, and infertility. Another report from Pories et al² in 1995 documented that in a cohort of 608 morbidly obese patients who received BPD, 83% of 146 patients with NIDDM, and 98.7% of 152 patients with abnormal carbohydrate tolerance displayed corrected levels of BG, insulin, and glycated hemoglobin (GHb) 4 months postoperatively before weight loss and without any other treatment.

Scopinaro et al³ reported that morbidly obese patients with NIDDM demonstrated improved blood glucose control 1 month postgastroplasty without any medication or dietary modifications. In 2003, Philip et al⁴ performed GBP on 1160 morbidly obese patients, 240 of which had impaired glucose tolerance or NIDDM. Of these patients with impaired glucose tolerance or NIDDM, 83% improved following GBP as indicated by normal levels of BG, insulin, and GHb without any other treatments at a 19.7 month mean follow-up period. In addition, 17% of patients had a reduction in their usual medication dosage and 1 patient with NIDDM had improved glycemic levels. Based on this evidence, bariatric surgery appeared to be a good therapeutic approach for NIDDM. Although it seems clear that bariatric surgery could be an important treatment option for morbidly obese NIDDM patients, the mechanisms involved are not well understood. Additionally, it is unclear if bariatric surgery is also beneficial to NIDDM patients without morbid obesity and IDDM.

Possible Mechanism

Traditionally it is thought that bariatric surgery improves diabetes by reducing caloric intake and decreasing weight.² However, based on the studies described here, it was noted that the time of insulin recovery in morbidly obese patients with NIDDM was earlier than significant weight loss after GBP. This suggested that diabetes was improved prior to weight loss rather than as a result of weight loss. Furthermore, in a small sample case-control trial 2004, Rubino and Marescaux⁵ observed that serum BG, insulin, insulin-like growth factor-1 and adrenocorticotrophic hormone decreased significantly before weight loss. Scopinaro et al³ published a report in 1998 that demonstrated that 1 month postoperatively, BG in all morbidly obese patients with NIDDM was restored to a normal level without any medical intervention. Rubino and Marescaux⁵ found that for nonobese NIDDM rats, gastric jejunum by-pass operations led to better control of BG than that of the sham operation group, diet group, or oral antidiabetic medicine group after 36 weeks. Rubino et al⁶ showed in 2006 in another animal experiment that for nonobese NIDDM rats, the gastric jejunum bypass operation group produced better control of BG levels after 4 weeks than the sham operation group, the simple gastrojejunostomy group, the ileum bypass operation group, and the gastric-jejunum bypass operation group, with no difference in food intake and weight loss within the groups. In this experiment, the rats in the gastric jejunum by-pass operation were surgically reverted to the original gastrointestinal anatomy. Rats in the simple gastrojejunostomy group underwent transection of the pylorus again to hinder food passage through the duodenum. The results indicated that the BG level in the former group rapidly increased in contrast to the BG level of the later group. It was concluded that food directly entering the jejunum without passing through the duodenum is a key mechanism involved in the BPD and GPD control of NIDDM. It is postulated that the BPD and GPD procedure may alter gastrointestinal hormone levels that control BG levels by way of removing duodenum and proximal jejunum from the enteroinsular axis.^{5–10}

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Status Quo of the Surgical Treatment of NIDDM

Surgical treatment of NIDDM can be performed via traditional operation or laparoscope operation. The modalities of operation mainly include Roux-en-Y GBP, BPD, and gastroplasty. All have curative effects for NIDDM. In 2004, Henry¹¹ published a meta-analysis which contained 22,094 cases and showed that GBP, BPD, and gastroplasty led to a mean weight loss of 68.2%, 70.1%, and 47.5%, respectively with a cure rate of 83.7%, 96.9%, and 47.9% for NIDDM. A 2004 case-control study by Lee et al¹² consisting of 645 cases showed no difference between GPD and gastric banding for morbidly obese patients in weight loss (38.4 ± 14.4 kg vs. 35.1 ± 16.8 kg, $P > 0.05$), and BG levels in morbidly obese patients with NIDDM after 1 year postoperatively. However, the incidence of early postoperative complications in the GBP group was higher than in the gastric banding group. In a case-control study of 106 morbidly obese patients, Weber et al¹³ reported that GPD was better than gastric banding in the control of GB, weight loss and overall patient satisfaction. Recently, a cohort study followed for 1 year by Cottam et al¹⁴ and a case-control study by Bowne et al,¹⁵ showed that the GPD group, compared with gastric banding, has advantages in reducing complications related to obesity and weight loss. Ballantyne et al¹⁶ however, analyzed the insulin resistance in another case-control study and found that both GPD and gastric banding improved insulin resistance equally. A randomized controlled trial by Angrisani et al¹⁷ showed that laparoscopic GPD and gastric banding had equal weight loss as well as resolution of diabetes, sleep apnea and hyperlipidemia. In 2006, a randomized controlled trial by Skroubis et al,¹⁸ with a 2 year follow-up, showed that BPD is better than GPD in diabetes control and weight loss. These studies indicated that GBP, BPD and gastroplasty are quite effective in NIDDM patients with morbid obesity.

Question to Be Answered

Diabetes mellitus is a lifetime disease. The situation of most patients with DM worsens with time.¹⁹ Bariatric surgery shows a promisingly high cure rate, not only to NIDDM patients with morbid obesity, but also for a number of other comorbidities of obesity such as hypertension, sleep apnea, infertility, and hyperlipidemia. For the patients in stable state of NIDDM and morbid obesity, the reports mentioned above can be regarded as a self-controlled study in which the conclusion could be considered to have high reliability.

These studies indicate that GBP, BPD, and gastroplasty each improve BG levels and reduce weight in obese patients with NIDDM. The gastroplasty procedure that precludes food passage through the duodenum significantly improves BG levels in morbidly obese patients with NIDDM. Therefore, the view that foods that do not pass through the duodenum leads to the change of gastrointestinal hormone secretion does not seem reasonable.

All of the clinical trials available for review were aimed at determining the effects of surgical procedures on NIDDM patients who are morbidly obese. Moreover, in contrast to GBP and BPD, the influence of gastroplasty on the early levels of BG and gastrointestinal hormone was rarely studied in detail. The long-term follow-up data was so poor that any reasonable comparison among the advantages of GBP, BPD, and gastroplasty was restricted. However, based

on these instructive studies, we believe that more targeted therapies or alternatives to surgery are important. Future work will clarify the mechanism involved in treating diabetes mellitus with surgical intervention.

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