Outcomes of Preoperative Weight Loss in High-Risk Patients Undergoing Gastric Bypass Surgery

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Hypothesis: Modest, preoperative weight loss will improve perioperative outcomes among high-risk, morbidly obese patients undergoing Roux-en-Y gastric bypass.

Design: A prospective, longitudinal assessment of characteristics and outcomes of gastric bypass patients.

Setting: All patients undergoing open or laparoscopic Roux-en-Y gastric bypass surgery for morbid obesity or its comorbid medical problems at Geisinger Medical Center in Danville, Pennsylvania, during a 3-year period from May 31, 2002, to February 24, 2006, were included in this analysis. Patients were required to participate in a standardized multidisciplinary preoperative program that encompasses medical, psychological, nutritional, and surgical interventions and education. In addition, patients were encouraged to achieve a 10% loss of excess body weight prior to surgical intervention.

Results: Of the 884 subjects, 425 (48%) lost more than 10% of their excess body weight prior to the operation. After surgery (mean follow-up, 12 months), this group was more likely to achieve 70% loss of excess body weight ($P_{<.001}$). Those who lost more than 5% of excess body weight prior to surgery were statistically less likely to have a length of stay of greater than 4 days ($P_{=.03}$).

Conclusions: This study shows that high-risk morbidly obese candidates for bariatric surgery who are able to achieve a loss of 5% to 10% excess body weight prior to surgery have a higher probability of a shorter length of hospital stay and more rapid postoperative weight loss.

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Obesity is a multifactorial disease encompassing genetic, environmental, metabolic, and socioeconomic etiologies that has reached epidemic proportions in the United States as well as around the world. Nearly 5% of the population now meets the criteria for morbid obesity: a body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) greater than 40. Thus far, the only effective long-term treatment for morbidly obese patients with obesity’s comorbid medical problems is bariatric surgery. To that end, older and higher-risk patients with multiple uncontrolled medical problems (such as diabetes mellitus, obstructive sleep apnea, steatohepatitis, degenerative joint disease, venous stasis disease, and cardiopulmonary vascular disease) are opting for bariatric surgery. Moreover, patients are seeking referral for bariatric surgery when the disease burden from their comorbidities eliminates meaningful quality of life.

Selected studies have shown that high-risk patients are facing much higher surgical risks than the morbidity and mortality rates described in recent peer-reviewed literature would indicate. Optimal preparation for high-risk individuals with significant comorbid medical problems remains controversial. Various modalities that possibly decrease risk, including preoperative weight loss, intragastric balloon placement, and staging procedures, have been described. Since its inception in 2000, the multidisciplinary preoperative surgery program at Geisinger’s Center for Nutrition and Weight Management (Danville, Pennsylvania) has encouraged a modest weight loss of up to 10% of excess body weight to control existing medical problems, such as diabetes mellitus, obstructive sleep apnea, steatohepatitis, and cardiometabolic syn-

See Invited Critique at end of article
drome. Although medical management for the primary treatment of morbid obesity has a greater than 95% failure rate over the long term, short-term modest weight loss has been shown to improve cardiometabolic parameters, thereby positively affecting the multiple medical problems.\(^5,6\) The goal of this study was to determine the potential impact of modest preoperative weight loss on hospital length of stay and overall weight loss following Roux-en-Y gastric bypass.

**METHODS**

The study included all patients undergoing open or laparoscopic Roux-en-Y gastric bypass for morbid obesity or its co-morbid medical problems at Geisinger Medical Center during a 3-year period from May 31, 2002, to February 24, 2006. (Patients undergoing laparoscopic adjustable gastric banding were not analyzed owing to the significant difference in surgical risk and length of stay as well as rate of weight loss postoperatively.)

Since 2001, all patients undergoing bariatric surgery at Geisinger Medical Center have been required to participate in a standardized multidisciplinary preoperative program that encompasses medical, psychological, nutritional, and surgical interventions and education. Patients must be tobacco free (documented by serum nicotine levels) for at least 6 months prior to the operation. Patients must also attend 2 educational sessions. A clinical nurse specialist, dietitian, and psychologist lead the first class. The second class is conducted by a bariatric surgeon. Additionally, the patients are required to read a book about bariatric surgery, complete 10 behavior modules, attend 2 support group meetings, and attempt to achieve a 10% weight loss of excess body weight. All of this must happen prior to any surgical intervention.

Initial weight loss was attempted through an approximate 500-kcal deficit from estimated calories consumed as determined by a registered dietitian. The macronutrient composition was a prudent low-fat diet. If patients following the diet had not reached their weight loss goal by month 4, they were instructed to follow a 1000- to 1500-kcal liquid diet. In addition, patients were encouraged to wear a pedometer and walk at least 8000 steps per day and drink at least 1.92 L of water daily, while avoiding caloric beverages. Monthly behavior modification modules were also reviewed with patients.

To determine weight change prior to bariatric surgery, BMIs from the first visit at the weight management clinic were compared with BMIs at the time of operation (as long as these dates were within 1 year of each other). These values were compared with their ideal body weight (a BMI of 25) to calculate the percentage of excess body weight loss prior to surgery. Subjects were placed into 5 groups: more than 5% excess body weight gain, 0% to 5% excess body weight gain, 0% to 5% excess body weight loss, 5% to 10% excess body weight loss, and more than 10% excess body weight loss.

Descriptive statistics were used to describe the study population. Analysis of variance and \(\chi^2\) and Fisher exact tests were used to compare demographics and comorbidity rates with preoperative weight loss. SAS, version 9.1 (SAS Institute Inc, Cary, North Carolina), was used for data manipulation and statistical analysis. All tests were 2-sided and \(P < .05\) was considered significant.

To determine if excess body weight loss prior to bariatric surgery was related to changes in excess body weight loss after bariatric operations, Kaplan-Meier survival curves and the Cox proportional hazards regression model were used. Specifically, these analyses estimated the time until a excess body weight loss goal was achieved for each preoperative weight loss group. The excess body weight loss goal was defined as excess body weight loss greater than 70% (measurement of surgical success). Furthermore, a Cox proportional hazards regression model was used to determine if the relationship between changes in excess body weight loss prior to bariatric surgery and changes in excess body weight loss after bariatric surgery remained after controlling for patient demographics and comorbidities. These analyses were conducted for the entire population and for the subsets of subjects with an initial BMI lower than 50 and those with BMI 50 or greater. Logistic regression was used to determine if differences in weight gain prior to bariatric surgery were related to length of hospital stay. To determine if the relationship between preoperative weight loss and outcomes were different based on type of operation, the interaction between type of operation (laparoscopic vs open) and preoperative weight loss group was considered in the modeling.

A total of 884 subjects were included in the analyses. The mean age was 45 years (SD, 10 [range, 18-72]) and 692 (78%) were female. The mean weight at the time of the operation for men and women was 171.8 kg (SD, 31.4) and 137.7 kg (SD, 23.2), respectively. The mean BMI at time of surgery was 51.3 (SD, 8.0). Height measured at the first nutritional visit was used for all BMI calculations. There was a mean 8.2 months between initial visit and surgery (SD, 2.15 [range, 1.2-12]).

The study population was observed up to 27 months postoperatively, with a mean follow-up of 11.2 months (SD, 7.89 [range, 1.4-27]). During follow-up, there was a mean of 7.8 weight measurements (SD, 3.7 [range, 1-32]). Preoperative weight loss did not significantly correlate with time between initial weight and operation, length of follow-up, or number of measurements.

Patients were grouped by excess body weight loss and compared for differences in demographic characteristics and comorbidities (Table 1). Age was significantly different \((P = .04)\), but the effect was relatively small (ie, difference in mean age) and likely to be clinically insufficient. Interestingly, initial weight \((P = .03)\) and BMI \((P = .004)\) were lower in the group that had a more than 5% excess body weight gain in the preoperative period. Sex and frequency of comorbidities were not significantly different among the preoperative weight loss groups.

Kaplan-Meier analyses revealed a significant relationship between preoperative weight loss and postoperative weight loss (Table 2 and Figure). Those with the largest excess body weight loss prior to surgery reached their goal excess body weight loss more quickly than those who had low excess body weight loss prior to surgery or those who had excess body weight gain prior to surgery. This relationship held for those with either an initial BMI less than 50 or for those with an initial BMI of 50 or greater.

Cox regression was used to estimate hazard ratios for achieving greater than 70% excess body weight loss (Table 3). Degree of preoperative excess body weight loss was used as the primary predictor variable (controlling for age, sex, and comorbidities) and was significant in all models. When the group with an excess body weight...
loss of 0% to 5% prior to surgery was used as a reference, those who lost more than 10% of excess body weight prior to surgery were 2.12 times more likely to achieve 70% excess body weight loss postoperatively (95% confidence interval, 1.50-3.01). There was little difference between those with 0% to more than 5% excess body weight gain and those with 0% to 10% excess body weight loss. Similar overall relationships were found when stratifying by initial BMI of less than 50 and BMIs of 50 or greater. However, the estimates were slightly stronger for those with initial BMIs of less than 50.

The distribution of the hospital lengths of stays for the 884 subjects was the following: 1 day, 5% of patients; 2 days, 59%; 3 days, 23%; 4 to 6 days, 9%; and 7 to 96 days, 4%. To determine if changes in weight prior to bariatric surgery were related to length of hospital stay, the length of stay was categorized into fewer than 4 days (87%) or 4 days or more (13%). Those with 5% to 10% excess body weight loss and those with more than 10% excess body weight loss prior to surgery were less likely to have a length of stay of 4 days or more ($P = .03$) compared with those with 0% to 5% excess body weight loss prior to surgery (Table 4). Type of operation did not influence the relationship between preoperative weight loss and length of stay ($P = .16$) or between preoperative weight loss and excess body weight loss greater than 70% ($P = .62$).

Table 1. Univariate Comparisons of Preoperative Weight Loss and Patient Demographics and Comorbidities

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Preoperative Excess Body Weight, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt; 5 Gain</td>
</tr>
<tr>
<td>No. of patients</td>
<td>67</td>
</tr>
<tr>
<td>Mean (SD) age, y</td>
<td>43 (11)</td>
</tr>
<tr>
<td>Age &gt; 55 y, %</td>
<td>19</td>
</tr>
<tr>
<td>Male sex, %</td>
<td>22</td>
</tr>
<tr>
<td>Mean (SD) initial weight, kg</td>
<td>135 (28.6)</td>
</tr>
<tr>
<td>Mean (SD) initial BMI^c</td>
<td>47.8 (7.6)</td>
</tr>
<tr>
<td>Initial BMI^c &gt; 50, %</td>
<td>34</td>
</tr>
</tbody>
</table>

Comorbidities, %

- Hypertension: 42 | 50 | 52 | 51 | 52 | .62^b |
- Diabetes: 27 | 37 | 35 | 39 | 36 | .52^b |
- Sleep apnea: 36 | 44 | 44 | 39 | 32 | .07^b |
- Hypercholesteremia: 27 | 34 | 30 | 37 | 36 | .44^b |
- Gastrointestinal reflux: 21 | 21 | 24 | 28 | 25 | .70^b |
- Depression: 25 | 27 | 22 | 23 | 22 | .88^b |
- Osteoarthritis: 21 | 19 | 22 | 24 | 23 | .86^b |
- Hypothyroidism: 10 | 14 | 13 | 14 | 12 | .94^b |
- Asthma: 9 | 6 | 10 | 8 | 11 | .67^b |
- Ischemic heart disease: 6 | 3 | 4 | 4 | 1 | .051^d |

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).

^a Analysis of variance.

^b $\chi^2$ Test.

^c Calculated as weight in kilograms divided by height in meters squared.

^d Fisher exact test.

Table 2. Percentage of Patients Achieving 70% Loss of Excess Body Weight by Preoperative Weight Loss

<table>
<thead>
<tr>
<th>Patients, %</th>
<th>Total Preoperative Excess Body Weight Change, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt; 5 Gain</td>
</tr>
<tr>
<td>All subjects, No.</td>
<td>67</td>
</tr>
<tr>
<td>6 mo (95% CI)</td>
<td>6 (0-12)</td>
</tr>
<tr>
<td>12 mo (95% CI)</td>
<td>28 (13-40)</td>
</tr>
<tr>
<td>Baseline BMI &lt; 50, No.</td>
<td>44</td>
</tr>
<tr>
<td>6 mo (95% CI)</td>
<td>9 (0-18)</td>
</tr>
<tr>
<td>12 mo (95% CI)</td>
<td>37 (17-52)</td>
</tr>
<tr>
<td>Baseline BMI^b ≥ 50, No.</td>
<td>23</td>
</tr>
<tr>
<td>6 mo (95% CI)</td>
<td>0</td>
</tr>
<tr>
<td>12 mo (95% CI)</td>
<td>10 (0-27)</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CI, confidence interval.

^a Log-rank test.
comes after a bariatric operation. Our results indicate that preoperative weight loss impacts both the perioperative length of stay and the extent of weight loss in the first postoperative year. Patients who lost more than 10% of excess body weight preoperatively were more than 2 times more likely to achieve 70% excess body weight loss. They were also less likely to have a prolonged length of hospital stay. Because the mean age of our patient population was relatively older and had significant disease burdens as well as higher BMIs than most surgical series, these results may not be applicable to all preoperative candidates for bariatric operations.

Several smaller studies have attempted to address the influence of preoperative weight loss on bariatric surgery outcomes with mixed results. In a randomized study of 100 patients, Alami et al7 compared bariatric surgery patients who had 10% preoperative weight loss with those who had no weight loss and found that operating time was reduced and postoperative weight loss was favorably affected. The authors found that preoperative weight loss did not affect morbidity rates. However, the cohort in this study included only 61 patients.

In a retrospective study of 90 patients who underwent laparoscopic gastric bypass, Alvarado et al8 showed that the preoperative loss of 1% of excess weight correlated with 1.8% greater postoperative weight loss at 1 year. In this study, a preoperative excess weight loss greater than 5% correlated significantly with shorter operative time. Age, sex, total number of comorbidities, number of complications, and resolution of comorbidities did not correlate with postoperative weight loss. In another small retrospective study, Liu et al9 compared 48 laparoscopic gastric bypass patients who lost 4.6% of excess weight preoperatively with 47 patients who gained 4.8% of excess weight preoperatively. There were no differences between the 2 groups in age, sex, comorbidities, or BMI at operation. These investigators observed that preoperative weight loss affected only intraoperative blood loss and the likelihood of encountering an enlarged liver. No differences were seen in operative time, length of hospital stay, wound infections, or major complications.

Our study involved a much larger cohort of patients observed in a prospective database who underwent both open and laparoscopic gastric bypass procedures. Even with this larger data set, the explanation for the observed relationship between preoperative weight loss and postoperative weight loss 1 year later is not clear. One possible explanation, though few data exist to support this contention, is that the mandate in this multidisciplinary preoperative program for 10% excess weight loss will identify the most motivated and compliant patients who would be likely to have the best postoperative weight loss. Another possible explanation is that the weight loss observations in this study reflect that preoperative weight loss simply allowed for earlier achievement of a predetermined goal weight and did not affect the ultimate weight loss result. The authors plan to revisit this data after a more lengthy postoperative period to better answer this question.

While the mode of surgical access (open or laparoscopic) had no influence, our study did not provide data that might explain the favorable results of preoperative weight loss on surgical length of stay. However, since the major determinant of perioperative length of stay is surgical morbidity, we postulate that physiologic improvements associated with preoperative weight loss reduce the rate of postoperative complications, which affect length of stay. Numerous reports have confirmed the beneficial effects of even limited weight loss on comorbid medical conditions, such as hypertension, diabetes mellitus, degree of visceral fat, liver size, thrombembolism predisposition, and severity of sleep apnea.

Figure. Kaplan-Meier curve estimating percentage of patients with postoperative excess body weight (EBW) loss greater than 70% (N=884).

### Table 3. Adjusted Hazard Ratios (HRs)a for Chance of >70% EBW Loss by Preoperative Weight Loss and Initial BMIb

<table>
<thead>
<tr>
<th>Preoperative Weight Loss, %</th>
<th>HR for &gt;70% EBW Loss</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All Patients</td>
<td>Patients With Initial BMI &lt; 50</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>Adjusted HR (95% CI)</td>
</tr>
<tr>
<td>&gt;5 EBW gain</td>
<td>67</td>
<td>1.16 (0.68-1.98)</td>
</tr>
<tr>
<td>0-5 EBW gain</td>
<td>86</td>
<td>1.08 (0.67-1.73)</td>
</tr>
<tr>
<td>0-5 EBW loss</td>
<td>137</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>5-10 EBW loss</td>
<td>189</td>
<td>1.20 (0.79-1.81)</td>
</tr>
<tr>
<td>&gt;10 EBW loss</td>
<td>425</td>
<td>2.12 (1.50-3.01)</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CI, confidence interval; EBW, excess body weight.

a Adjusted for age, sex, and presence of comorbidities.
In this large study, preoperative weight loss resulted in a shorter length of stay and a more rapid weight loss postoperatively. With bariatric surgery quickly becoming the mainstay of treatment for the morbidly obese patient, such a regimen may have significant clinical impact. However, because of the older age, high disease burden, and high BMIs of this population, these results may not be applicable to all preoperative candidates for bariatric surgery. Further studies to extend these results and to evaluate the effects on preoperative weight loss of specific surgical outcomes as well as its correlation with long-term weight loss are ongoing.

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### REFERENCES