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Nutrition After Vertical Banded Gastroplasty

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The authors assessed the nutritional status of 60 morbidly obese patients by determining body composition, using multiple isotope dilution at 13.6 ± 0.4 months following operation. Body weight was followed for an additional 12.3 ± 0.8 months. Twenty-four patients lost more than 25% of their preoperative weight and were within 30% of ideal weight (a "good" result). At 1 year they had lost 41.4 ± 1.8% of preoperative weight and the body mass index (BMI) decreased from 46.7 ± 1.2 to 27.0 ± 0.6 kg/m². Despite rapid weight loss, malnutrition did not develop and their body composition became indistinguishable from that of normally nourished volunteers. Twenty-nine patients had a "satisfactory" result with more than 25% weight loss but were not within 30% of ideal. Their weight decreased by 34.8 ± 1.0% as their BMI decreased from 55.4 ± 1.2 to 36.0 ± 0.8 kg/m². Seven patients lost less than 25% of their preoperative weight (an "unsatisfactory" result). Malnutrition did not develop in any patient. In the authors' experience, in contrast to other weight reducing operations, vertical banded gastroplasty (VBG) results in rapid weight loss without the concomitant development of malnutrition even in patients who return to normal weight.

MALNUTRITION COMMONLY OCCURS in patients who have had significant weight loss following operations for morbid obesity.[1,2] The malnutrition that develops following jejunoileal bypass has been classified as kwashiorkor in type, as it is associated with hepatic dysfunction and is similar to what occurs with protein deprivation without carbohydrate restriction. These patients usually have a reduction in the plasma concentrations of essential amino acids, an elevation of plasma glycine, and a favorable therapeutic response either to intravenous amino acids or to restoration of intestinal continuity.[3,4]

In contrast, operations designed to limit intake result in a decreased intake of both calories and protein, and malnutrition more closely mimics marasmus, in which liver failure is rare but vitamin deficiencies are common.[1] Patients with malnutrition following intake-limiting procedures exhibit weakness, easy fatigue, a failure to return to their former occupation,[1] repeated infections and immunologic incompetence,[5] Wernicke-Korsakoff disease,[6] and vitamin B-12 and folic acid deficiencies. Nutritional studies of gastric limiting operations until now have been confined to gastric bypass or to horizontal gastroplasty. The malnutrition that develops following both jejunoileal bypass and gastric limiting operations is characterized by an abnormal contraction of the body cell mass (BCM) with an expansion of extracellular mass (ECM).[1,2]

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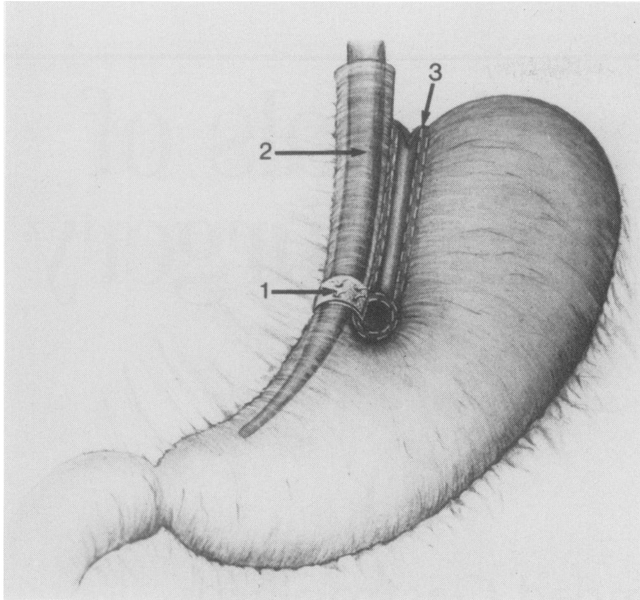


FIG. 1. Vertical banded gastroplasty (1) polypropylene band created an external circumference of outlet orifice of 55 mm in two patients, 50 mm in seven patients, and 41–45 mm in 51 patients; (2) 26 Fr bougie within new gastric pouch; and (3) vertical staple line.

In this study, we measured body composition by multiple isotope dilution in 60 patients 13.6 ± 0.4 months after vertical banded gastroplasty (VBG) to document the nutritional consequences of this popular operation for the control of morbid obesity. We followed the stability of weight loss by measuring weight change for an additional 12.3 ± 0.8 months following the measurement of body composition.

Materials and Methods

Patient Selection

All patients entered into the study were at least twice ideal weight, had a body mass index (BMI) of 50.7 ± 1.0 kg/m^2, and were considered capable of participating in an exacting postoperative follow-up program. After surgery all patients were seen weekly for 1 month, monthly for 1 year, and then bimonthly by a research dietitian, the surgical staff, and by a psychiatrist if necessary. Weight, height, and ideal weight[7] were recorded for each patient before and at the stated intervals after surgery.

Operative Procedure

We performed VBG on all 60 patients.[8] A single layer of polypropylene mesh was used to band the orifice of the proximal gastric pouch (Fig. 1). This material was cut 15 mm wide and 60–70 mm long and overlapped to create an external circumference of 55 mm in two patients, 50 mm in seven patients, and 41–45 mm in 51 patients. The material used for banding was sutured to itself and not to the gastric wall using 4 polypropylene sutures. A No. 26 Fr bougie was used as a guide to establish the size of the gastric pouch. We used two rows of 4.8 mm vertical staples in all patients.

Measurement of Body Composition

Body composition was determined by multiple isotope dilution[9] at a mean of 13.6 ± 0.4 months after surgery. These measurements involved the simultaneous intravenous injection of 8 μCi of sodium-22 and 500 μCi of tritiated water. The plasma isotope concentrations were determined at 4 and 24 hours following isotope injection. All of the urine and any extrarenal fluid lost during the 24-hour isotopic equilibration period were collected to correct for isotope loss. Total exchangeable sodium (Na_e) was determined from the equilibrated plasma sodium-22 specific activity at 24 hours. Total body water (TBW) was calculated from the equilibrated plasma tritium concentration at 24 hours. Total exchangeable potassium (K_e) was calculated from TBW, Na_e, and the ratio in whole blood of the sodium plus potassium content divided by its water content. Lean body mass (LBM), body fat, and BCM were calculated from equations previously published.[10] The Na_e/K_e ratio is a sensitive index of the nutritional state. In the normally nourished this ratio approximates unity with an upper 95% confidence limit of 1.22. Malnutrition is characterized by a loss of BCM, accompanied by an expansion of the ECM, and thus an increase in the Na_e/K_e ratio. Malnutrition was therefore defined by a Na_e/K_e ratio greater than 1.22.[9] Because many preoperative body composition measurements have been recorded in obese patients, only postoperative nutritional measurements were performed in this study. The postoperative body composition data were compared to similar data obtained in 25 normally nourished healthy volunteers and in 100 preoperative morbidly obese patients.

Evaluation

We performed endoscopy with an 11-mm endoscope at 6 weeks, 6 months, and 1 year following gastroplasty to determine stoma size and the continuity of the vertical staple line separating the new small stomach from the gastric fundus. An upper gastrointestinal x-ray series was also obtained to rule out staple line disruption at 1 year and repeated later if clinically indicated.

Patients were individually classified on the basis of weight loss as "good" (if the weight loss after operation exceeded 25% of preoperative weight and was within 30% of ideal weight), "satisfactory" (if weight loss exceeded 25% but the patient still exceeded 30% of ideal),

TABLE 1. *Nutritional Status Following Vertical Banded Gastroplasty (13.6 ± 0.4 Months)*

	Normal	Good	Satisfactory	Unsatisfactory
	Controls			
Patients	25	24	29	7
Weight (Kg)	70.4 ± 2.5	72.4 ± 2.2*	96.5 ± 2.8	89.2 ± 5.3
Weight loss (%)		41.4 ± 1.8	34.8 ± 1.0	21.0 ± 0.9
Fat (Kg)	20.1 ± 1.4	23.4 ± 1.7*	39.4 ± 1.7	39.2 ± 3.2
Body cell mass (Kg)	24.6 ± 1.1	22.5 ± 1.2	25.4 ± 1.0	23.6 ± 1.6
Na_e/K_e	0.98 ± 0.02	1.09 ± 0.04	1.14 ± 0.03	1.03 ± 0.07
Vitamin B-12 (% normal)		92	93	100
Folate (% normal)		67	59	71
Iron (% normal)		91	66	71
Stoma (% <11 mm—with intact vertical staple line)		100	86	29

* $p < 0.05$ between good and both satisfactory and unsatisfactory.

and "unsatisfactory" (if the weight loss was less than 25% of preoperative weight). These patients were followed closely for weight change for an additional year (12.3 ± 0.8 months) following the body composition measurement. The patients also were classified at 13.6 ± 0.4 and 25.9 ± 0.8 months as excellent, good, fair, poor, or failure using the criteria of Reinhold.[11]

Assessment of Food Intake

Patients recorded their food intake over a 7-day period immediately prior to the measurement of body composition. Types and quantities of foods consumed were recorded using the diary method. A research dietitian reviewed the food intakes for accuracy and classified them as A (a solid diet consisting of all foods), B (a soft diet with complete variety), and C (purees and/or liquids only).

Biochemical Measurements

Fasting blood specimens were analyzed before surgery and at 6-month intervals for blood glucose, total serum cholesterol, alkaline phosphatase, serum aspartate amino transferase (AST), serum alanine amino transferase (ALT), and serum lactic dehydrogenase (LDH).

Blood samples for vitamin determinations were drawn from the 60 patients following an overnight fast at the time body composition was determined. Serum or whole blood samples were analyzed for vitamin B-12,[12] folic acid,[13,14] and iron.[15]

Statistical Analysis

We used analysis of variance to evaluate the significance of differences. A p value of less than 0.05 was considered to be significant. Means were calculated with the corresponding standard error of the mean (SEM).[16]

Results

Body Composition, Body Mass Index, Weight

Table 1 and Figure 2 summarize the body composition and clinical results at 13.6 ± 0.4 months following operation. The patients were divided into three groups on the basis of their postoperative weight loss. Twenty-four patients had a good result, a loss of more than 25% of preoperative weight and a final weight within 30% of ideal weight. Twenty-nine patients had a satisfactory result, a loss of more than 25% of preoperative weight but a final weight greater than 30% of ideal weight. The remaining seven patients had an unsatisfactory result. Body composition data of 100 preoperative morbidly obese subjects and 25 normally nourished healthy volunteers are included for comparison. The mean preoperative body weight for each group is also included in Figure 2.

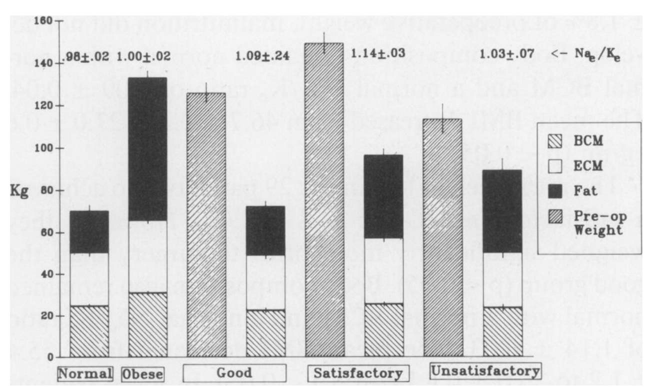
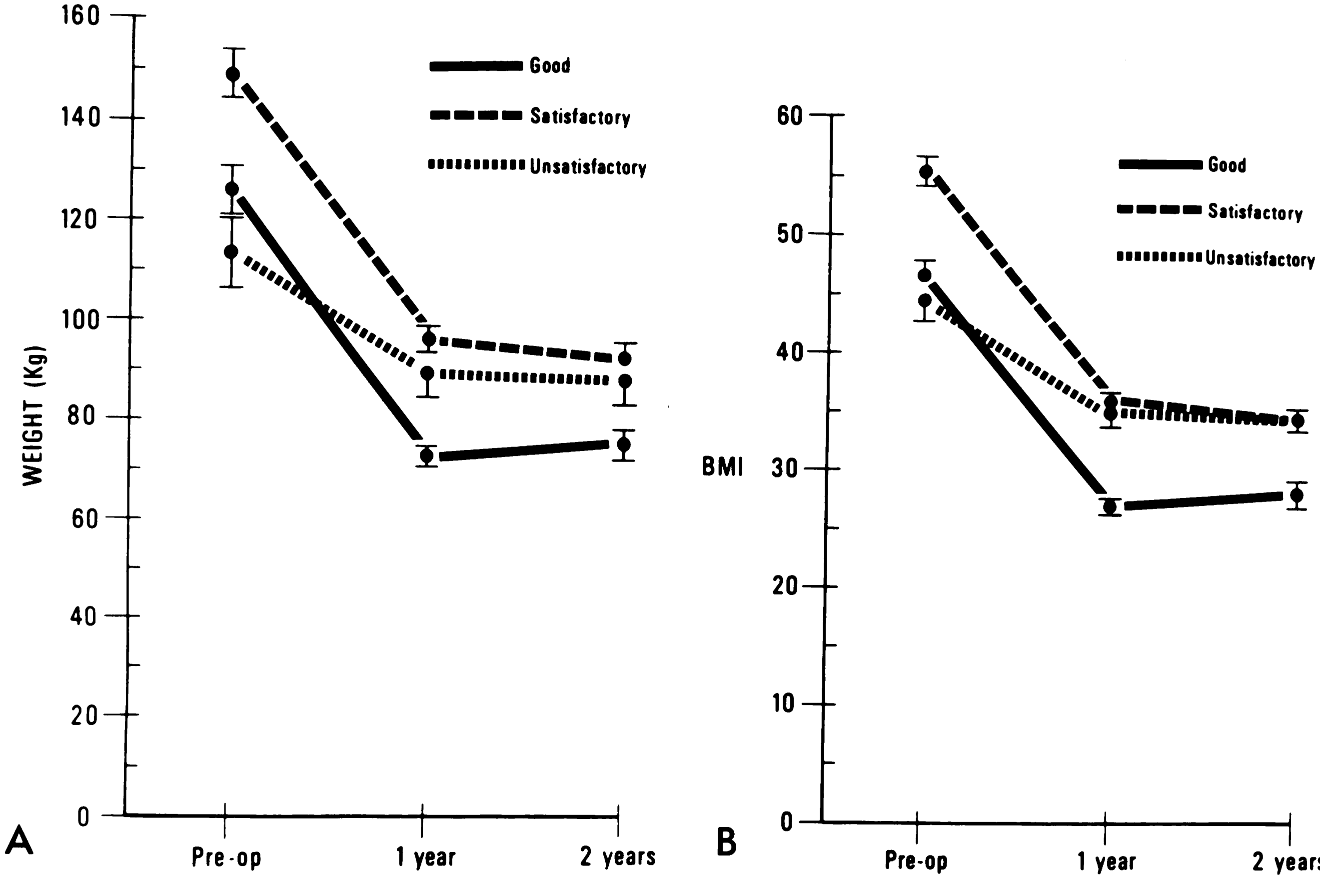


FIG. 2. Body composition of 25 normal controls (Normal); and of 100 obese patients prior to surgery (Obese); preoperative and postoperative weights and body composition at 13.6 ± 0.4 months after VBG are shown in 24 patients who achieved a good result, for 29 patients listed as satisfactory, and seven patients who achieved an unsatisfactory result. The Na_e/K_e ratio is shown for each group and controls. Malnutrition did not occur in any patient even though weight loss was rapid and great, especially in the good group. See text for definition of groups.



FIGS. 3A and B. Weight (*A*) and body mass index (*B*) changes 1 and 2 years after VBG in three groups of patients who achieved either a good, satisfactory, or unsatisfactory result. There was no significant weight change during the second year.

The mean body composition of the 24 patients with a good result at the time of evaluation was indistinguishable from normal. In spite of a mean weight loss of 41.4 ± 1.8% of preoperative weight, malnutrition did not develop. Body composition remained normal with a normal BCM and a normal Na_e/K_e ratio of 1.09 ± 0.04. The mean BMI decreased from 46.7 ± 1.2 to 27.0 ± 0.6 kg/m^2 ($p < 0.05$).

The mean weight loss in the 29 patients who achieved a satisfactory result was 34.8 ± 1.0%. However, they weighed significantly more prior to surgery than the good group ($p < 0.05$). Body composition also remained normal with a normal BCM and a normal Na_e/K_e ratio of 1.14 ± 0.03. The mean BMI decreased from 55.4 ± 1.2 to 36.0 ± 0.8 kg/m^2 ($p < 0.05$). In seven patients an unsatisfactory result occurred, with weight loss less than 25% of preoperative. Their nutritional status remained normal with a normal body composition.

The body fat of the good group returned to within normal limits. The postoperative body fat in this group was significantly ($p < 0.05$) less than the body fat in either the satisfactory or unsatisfactory groups. In all three groups no further weight loss occurred during the second postoperative year (Figs. 3A and B).

Early Surgical Follow-up

All patients with a good result and 86% of patients with a satisfactory result had an orifice of less than 11 mm in diameter at 1 year. At that time, staple line disruption had not occurred in any patient in either the good or satisfactory group.

In the unsatisfactory group a stoma size greater than 11 mm diameter was present in three patients and six of seven patients had developed a disruption in the vertical staple line.

Specific Nutritional Deficiencies

The percentage of patients with decreased serum concentrations of vitamin B-12, red blood cell folate, and serum iron are listed in Table 1. In all groups a significant number of patients had an abnormal reduction in

TABLE 2. *Diet Following Vertical Banded Gastroplasty*

Results	Total Patients	Consistency of Diet A	B	C
Good	24	9	8	7
Satisfactory	29	9	13	7
Unsatisfactory	7	3	4	0

TABLE 3. *Change in Results Between 1 and 2 Years Following Vertical Banded Gastroplasty*

13.6 ± 0.4 Months	25.9 ± 0.8 Months		
	Good	Satisfactory	Unsatisfactory
24 Good	21	1	3
29 Satisfactory	2	23	3
7 Unsatisfactory	1	1	5
Total	24	25	11

the serum concentrations. However, a clinical deficiency state was not identified.

Dietary Habits

At 1 year 21 patients were eating a solid diet restricted only in quantity (an A result), 25 patients were ingesting a soft diet, and 14 patients were only able to take a pureed or a liquid diet. The distribution of these patients in reference to clinical result appears in Table 2. A good or satisfactory clinical result did not depend on intake of a low consistency diet. However, the majority of patients were ingesting a soft or pureed diet even a year after surgery.

Late Follow-up

All 60 patients were evaluated approximately 2 years (25.9 ± 0.8 months) after surgery, or 12.3 ± 0.8 months following the body composition measurement, to determine the stability of the weight loss (Tables 3 and 4). The method of Reinhold[11] is also included in Table 4 to evaluate weight loss as a percentage of excess weight. No patients have been lost to follow-up. Of the 24 patients with a good result at 1 year, one became satisfactory due to enlargement of the outflow banding because of migration of the polypropylene mesh into the gastric lumen. Three became unsatisfactory due to weight gain, the result of vertical staple line disruption (Table 3).

Of the 29 patients who had a satisfactory weight loss at 1 year, three patients became unsatisfactory due to disruption of the vertical staple line. However, two patients improved from satisfactory to good because of decreased caloric intake. Two patients converted from unsatisfactory to satisfactory due to slow but continued weight loss and one patient converted to good as a result of behavior modification and a decreased caloric intake. Seven patients were unsatisfactory after 1 year. After 2 years 11 had an unsatisfactory result, all due to either a staple line disruption or an outlet orifice that was too large (> 11 mm). An external band circumference that is made greater than 50 mm results in an outlet orifice as measured at endoscopy of > 11 mm.

Biochemical Results

An elevated fasting plasma glucose was present in 21 patients before surgery. The mean fasting plasma glucose was 151 ± 13 mg/dL. At the time of body composition studies the mean plasma glucose was 85 ± 3 mg/dL and was within normal limits in all but three patients. None of these patients required medication for hyperglycemia.

An elevated fasting serum cholesterol of greater than 280 mg/dL was found in only one patient. The value decreased from 286 to 237 mg/dL at 1 year. The mean cholesterol level for all patients before operation and at 1 year was 191 ± 5 mg/dL and 182 ± 5 mg/dL, respectively.

An elevated alkaline phosphatase was found before surgery in 30 patients. The mean of 142 ± 8 U/L declined to 86 ± 3 U/L at 1 year. Only four patients had a persistent elevation of serum alkaline phosphatase after operation.

Serum aspartate amino transferase was abnormally elevated before operation in eight patients to 61 ± 4

TABLE 4. *Weight Loss and Results*

	13.6 ± 0.4 Months	25.9 ± 0.8 Months
Percentage of weight loss	35.3 ± 1.3	36.1 ± 1.2
Percentage of excess weight loss	67.4 ± 2.2	66.7 ± 2.8
Result*		
Good	24 (40%)	24 (40%)
Satisfactory	29 (48%)	25 (42%)
Unsatisfactory	7 (12%)	11 (18%)
Results†		
Excellent (<25% excess weight)‡	17 (28%)	15 (25%)
Good (26–50% excess weight)	28 (47%)	27 (45%)
Fair (51–75% excess weight)	12 (20%)	16 (27%)
Poor (76–100% excess weight)	2 (3%)	2 (3%)
Failure (> −100% excess weight)	1 (2%)	0 (0%)

* See reference 4.

† See reference 11.

$$\ddagger\ \%\ \text{excess weight} = \frac{\text{weight at evaluation} - \text{ideal weight}}{\text{ideal weight}} \times 100.$$

U/L. After surgery this returned to 18 ± 6 U/L. One patient remained abnormal after surgery. Serum alanine amino transferase was abnormally elevated before operation in 20 patients to 80 ± 12 U/L. After surgery this returned to 19 ± 3 U/L and all patients were within normal range.

Serum lactic dehydrogenase was abnormally elevated before operation in 25 patients to 279 ± 9 U/L, and in these patients it returned to 178 ± 6 U/L after operation. One patient continued to remain abnormal.

Discussion

The objective of our surgical approach to morbid obesity is to minimize the physical risks of obesity by restoring weight to within 30% of ideal without the induction of malnutrition. This was achieved in 24 of the 60 patients. At 1 year following VBG these patients had lost 41.4 ± 1.8% of their preoperative body weight. An additional 29 patients achieved a satisfactory result. In this group weight loss exceeded 25% of preoperative weight, but weight was not within 30% of ideal. At 1 year only seven patients had lost less than 25% of their preoperative weight. Their mean weight loss was 21.0 ± 0.9%.

In spite of the large weight loss at a relatively rapid rate, malnutrition did not develop in any patient. Except for excessive body fat, the body composition of all the patients at 1 year was normal with a normal BCM and a normal Na_e/K_e. The weight decrease was due to a loss of body fat without a loss of BCM. In similar studies of patients after jejunoileal bypass, horizontal gastroplasty, and gastric bypass, this degree of weight loss was associated with a significant incidence of malnutrition, which at times was life-threatening.[1,2]

The development of malnutrition following weight reduction surgery is generally not well appreciated. This is because in the studies that have monitored body composition following weight reduction surgery the LBM, not the BCM, was measured.[17,18] The LBM is not, however, a sensitive measure of the nutritional state. Malnutrition results in a loss of BCM accompanied by an expansion of the ECM and, as a result, the LBM does not change. In 75 severely malnourished individuals, there was a 41% reduction in the BCM with a concomitant 24% expansion of the ECM.[9] The LBM in these severely malnourished individuals was not significantly different from normally nourished individuals. Thus, to monitor the nutritional state following weight reducing surgery it is essential to measure the two components of the LBM: the BCM and the ECM.

We have previously reported the effect of jejunoileal bypass[2] on the nutritional status of 44 morbidly obese patients evaluated in a similar fashion. The operation involved anastomosing 15 inches of proximal jejunum, end-to-side, to 5 inches of distal ileum. Body composition remained normal after bypass in 33 patients, and at 1 year body weight had decreased by 24.4 ± 2.1%. This loss of body weight resulted entirely from a loss of body fat. Malnutrition developed in 25% or 11 patients. In these patients at 1 year the weight loss was 27.0 ± 3.0% while the BCM decreased by 22.6 ± 6.1%. Their body composition was characteristic of malnutrition with a contracted BCM, expanded ECM, and elevated Na_e/K_e. The metabolic complications associated with small bowel bypass occurred only in the patients who developed an abnormal body composition. Repeated hospital admissions were required because of these metabolic complications, which included malaise, anorexia, debilitating weakness, hypokalemia, and liver failure. Protein malnutrition was responsible for the observed abnormalities as the infusion of amino acids, without additional nonprotein calories, returned the body composition to normal and successfully corrected both the metabolic derangements and the abnormal liver function. Subsequently over several months, a high protein diet prevented the recurrence of symptoms and maintained a normal body composition. However, over several years bowel continuity was restored in almost all of the patients because of the difficulty they experienced in maintaining a high protein intake. Restoration of bowel continuity always restored both liver function and body composition to normal.

We have previously described the nutritional consequences of horizontal gastroplasty or gastric bypass[1] in 96 morbidly obese patients. In 49 patients, body composition remained normal at 24 months, with a 25.7% loss of body weight and a 36.2% loss of body fat. Malnutrition developed in 49% or 47 patients. In these patients weight loss was 25.9%, body fat decreased by 34.4%, and the BCM decreased by 29.4%. Malnutrition developed in patients with a small stoma and was associated with hair loss, lassitude, easy fatigue, and difficulty in attaining full employment. Liver failure did not occur. The body composition of all the malnourished patients eventually returned to normal. In 19 patients this occurred as the stoma enlarged spontaneously. Eight patients were successfully treated with dietary counseling. The orifice was enlarged by operation in 18 and by endoscopic dilatation in two patients.

All weight reducing operations are designed to reduce either the intake or absorption of food. To achieve adequate weight loss with jejunoileal bypass, a malabsorption state is created by limiting the length of functioning small bowel. However, if the length of small bowel remaining in circuit is too short, protein malnutrition develops. Furthermore, for the individual patient it is not possible to determine the appropriate length that must remain in circuit. The margin of error in measurement is small and hypertrophy of the remaining bowel in circuit is variable, adding to the unpredictability of this operation to produce adequate weight loss without inducing malnutrition.

The gastric weight reducing operations create a resistance to the movement of food out of the gastric pouch. With gastric bypass and horizontal gastroplasty, this is achieved by limiting both the reservoir capacity and the cross-sectional area of the outlet orifice. If the orifice is too small or eccentrically placed, vomiting and malnutrition can develop. If it is too large, weight loss is insufficient. Because the cross-sectional area is related to the $(\text{radius})^2$, small differences in the radius of the outlet orifice result in large differences in the cross-sectional area and thus to the resistance to the movement of food out of the stomach. Since narrowed orifice in the horizontal gastroplasty and gastric bypass as we performed it[1] is extremely short, it had to be constructed very small to limit flow and induce weight loss. This caused vomiting and malnutrition in a significant number of patients. This problem has been partially overcome with the VBG. With this operation, the resistance to the movement of stomach contents is not critically related to a very short but severe narrowing of the outflow tract. Vomiting is unusual after VBG for several reasons. The orifice is larger than that found effective after horizontal gastroplasty. The orifice is easily placed in the dependent position. The banding material very rarely migrates, which can cause narrowing of the orifice from the gastric pouch, and it is easier to make a smaller pouch in the vertical rather than in the horizontal position. Furthermore, by surrounding the dependent portion of the new pouch with nonelastic polypropylene mesh, the size of the orifice does not expand with time. It is not known presently how the gastric pouch changes in capacity with time. With this operation, 88% of the patients experienced a good or satisfactory result without the development of malnutrition in a single patient. This is in sharp contrast to the experience with the other weight reducing operations tested.

The operation performed in this study results in a smaller outflow tract of the new gastric pouch than the vertical banded gastroplasty described by Mason.[8] In the majority of patients the banded external circumference was 45 mm or less. The creation of an orifice of this size resulted in rapid weight loss, but was probably also responsible for the high rate of verticle staple line disruption herein reported.

At 2.2 ± 0.1 years after surgery, disruption of the staple line had developed in 14 of the 60 patients with an unsatisfactory weight loss in nine. Gastrointestinal x-ray examination and repeated endoscopy have both demonstrated that staple line disruptions enlarge with time. Most staple line perforations will probably result in an unsatisfactory result given enough time because of progressive enlargement of the communication between the new gastric pouch and the gastric fundus. This gives rise to an increased ability to eat and is associated with loss of the sense of satiety after eating small meals, which is so common in patients with intact gastric limiting operations. Loss of the feeling of satiety with small meals has prompted examination for staple line integrity in many patients and frequently has identified disruptions as the cause. Unless this complication is looked for very carefully, an inferior result can be attributed to the operation as designed.

Enlargement of the banded area of the gastroplasty occurred in only one patient in this series. This rare post-VBG complication was due to the migration of the polypropylene mesh into the lumen, with resulting enlargement of the orifice.[19] When supporting sutures, pledgets, or silicon rings are sutured to the stomach or placed near an anastomosis, migration of the material designed to maintain a constant orifice size occurs frequently.[1] All operations that depend on these materials sutured to the gastric wall or placed around or near an anastomosis are probably unacceptable. In contrast, polypropylene as used in the VBG has been dependable in maintaining orifice size with a very low incidence of migration.[19,20]

Staple line disruption occurs because the tissue between the anterior and posterior gastric walls does not heal together. In our study 4.8-mm staples were used. Lechner and Elliott[21] use 3.5-mm staples to ensure crushing and sealing between the anterior and posterior walls of the stomach. We have found that on dividing between vertical staple lines made with both 3.5- and 4.8-mm staples on the stomach, there is sufficient bleeding to require surgical hemostasis. If division between the staple lines is not done, the tissue at that site can remain viable and if the staples migrate a potential passage can develop between the new small pouch and the fundus of the stomach.

Vertical banded gastroplasty is capable of inducing impressive weight loss without malnutrition but fails in our experience, in many instances, because of staple line disruption. This complication has been previously reported.[20] For this reason we have for several months divided between the vertical staple lines in all patients undergoing VBG.

The inability to clear glucose adequately from the blood is common in obesity and may occur in the absence of clinically manifest diabetes mellitus. This was the case in 21 of the patients in this series with elevated fasting blood glucose. All but three had a complete and prompt decline in fasting blood glucose to normal with weight loss. An unsatisfactory weight loss occurred in one of the three. Several reports document the elimination of the requirement for insulin or other hypoglycemic agents in obese type II diabetics who lose weight after gastric surgery.[22,23,24]

Steatosis with abnormalities of liver function occurs commonly in obesity. In 45 of the 60 patients, one or more liver function tests were abnormally elevated before surgery. Approximately 1 year following surgery, liver function tests were normal in all but six of the 60 patients. The weight loss was good in one, satisfactory in three, and unsatisfactory in two of the six patients. In contrast, liver dysfunction is common after intestinal bypass and is especially severe in patients who develop malnutrition. Correction of the contracted BCM by intravenous amino acids or by surgical restoration of normal intestinal continuity promptly reverses even severe liver failure.[3]

All patients took a multivitamin preparation that contained 5 μg of vitamin B-12 and 0.1 mg of folic acid each day. Iron was not given routinely. No anemia developed during the 2 years of follow-up. However, serum and/or red blood cell deficiencies of vitamin B-12, folate, and iron did occur without clinical manifestation. This is in contrast to the report of Amaral et al.,[25] who described anemia in 37% of patients 20 months after gastric bypass, with a low serum iron concentration in 48.6% and a low serum vitamin B-12 concentration in 70%. These deficiency states might be expected to be lower with VBG, which does not bypass the duodenum and stomach. The final conclusion and recommendations for both operations is that careful and permanent follow-up for nutritional deficiencies be carried out.

In this study the 1983 Metropolitan height-weight tables[7] were used and the BMI[26] was calculated as (weight)/(height)^2(kg/m^2) to assess both the patients' preoperative status and the postoperative result. The BMI is a measure of the degree of obesity, with a high correlation with direct measures of body fat. It is simple to calculate and is more precise than skinfold measurements.[27]

A BMI in the range of 20–25, which was defined by Garrow[28] as Grade 0 obesity, is associated with minimal mortality and is equivalent to the insurance 'desirable weight' range. A BMI of 25–30 is Grade I obesity. The increase in mortality is minimal. Grade II obesity is a BMI of 30–40 and represents the transition from clinically trivial to crippling obesity. At the midpoint of this range, mortality is roughly double that found in the desirable weight range. Morbid obesity or Grade III obesity is a BMI over 40 and is usually incompatible with normal employment. Insurance statistics on mortality in Grade III obesity become unreliable because these individuals have difficulty obtaining insurance.[28] Patients in the upper ranges of Grade II obesity have an expected mortality three times that of individuals of normal weight in the same age group. The mortality ratio increases rapidly as BMI increases from 30 to 40.[27]

Drenick et al.[29] have reported a startling 12-fold increase in mortality in morbidly obese men between ages 25 and 34 when followed for a mean of 7.6 years. In the age group 35 to 44 years there was a six-fold excess mortality.

The effect on overall mortality resulting from a surgically induced weight loss is not easily measured at this time. While patients in the satisfactory group have lost a significant amount of weight with a decline in BMI from 55.5 ± 1.2 to 36.0 ± 0.8, it remains to be proven that this degree of weight loss will significantly decrease the physical risks associated with morbid obesity. It is likely that these patients remain at a two- to three-fold risk for mortality compared to controls of desirable weight even after surgically induced weight loss. Whether the patient has arrived at that point from a 12-fold or a four-fold increase in mortality over citizens of desirable weight is not yet clear. This type of reporting with estimates of physical risk and use of the BMI should be more widely used by surgeons assessing results in these patients.

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