Gastric Bypass for Morbid Obesity

A Medical–Surgical Assessment

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With the operative modifications and dietary guidelines described in this report, death and complications from gastric bypass were minimal, and weight loss was marked. Ninety per cent of a group of 69 patients lost more than half of their excess weight within the first two years after operation. Stringent preselection of patients for operation was crucial to the success of the operation, and marked alterations of eating behavior was necessary to achieve the weight loss. Mild electrolyte deficiencies and hypovitaminosis occurred in up to one-fourth of the patients. While none of these abnormalities was harmful to the patients, and all were easily corrected, their occurrence demonstrates the importance of long-term follow-up after the operation. We conclude that gastric bypass, with a 50–60 cc pouch and a small (1–1.2 cm) gastrojejunostomy, remains the operation of choice for morbid obesity.

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GASTRIC RESTRICTION PROCEDURES for morbid obesity have become the most popular form of surgical relief of obesity[1,2] in the decade since Mason and Ito first reported results after gastric bypass.[3] Several reports appeared which prospectively compared gastric bypass with jejunoileal bypass, and which demonstrated not only similar short-term weight loss, but a lower incidence of metabolic complications with the former.[4–6]

More recent gastric restriction operations include gastroplasty,[7] gastric partition[8] and gastrogastrostomy. All of these procedures depend for success upon the creation of a small proximal gastric pouch to produce early satiety, and upon a small outflow tract from that pouch to delay gastric emptying and, hence, the return of hunger. While all of these operations are demonstrably safer than jejunoileal bypass, there is a predictable morbidity and mortality rate with each. Nevertheless, comparatively little has been reported about the long-term complications of the various gastric procedures.

Determining the success of any weight-reducing procedure is complex, and must consist of a detailed analysis of weight loss and the factors which influence that loss. The benefits of the weight loss, in turn, must be weighed against the risks of the operation, both short- and long-term.

This report discusses the complications of a group of 69 (GAB) patients who underwent gastric bypass operations at Barnes Hospital/Washington University Medical Center between 1977 and 1980. Emphasis is placed on late metabolic changes which occurred, and data are presented showing the impact of this operation on the lives of the patients. Weight loss in these patients is discussed more fully elsewhere.[9]

Methods

Sixty-nine morbidly obese patients were evaluated before operation in the Clinical Research Center of the Washington University School of Medicine. Informed consent was obtained in accordance with the guidelines of the Human Experimentation Committee. Concomitant pulmonary and cardiovascular disease, and endogenous causes of morbid obesity were excluded by screening tests, which included dexamethasone suppression, thyroid function studies, and skull series. Anesthesiology and psychiatry consultations were obtained on all patients. In addition, radiographic examination of the entire gastrointestinal tract was obtained

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before operation, as well as intravenous urogram, oral cholecystogram, and sigmoidoscopy.

The following criteria were used to select patients for operation:

1) Weight > 100% above ideal weight
2) Documentation of prolonged attempts at weight reduction under direction of physician or dietician
3) Exogenous obesity
4) Good general health, with no history or evidence of peptic disease
5) Psychiatrically stable with realistic expectations for operation: a) acceptance of need for extreme caloric restriction postoperatively; b) acceptance by patient of responsibility for long-term weight loss; c) realistic view of the likely impact of weight loss on patient's life.

TABLE 1. *Preoperative Data on 69 Morbidly Obese Patients who had Gastric Bypass*

	Women	Men
Number	60	9
Preoperative weight (kg)	130 ± 19	143 ± 30
Height (cm)	26 ± 1	28 ± 2
Age (years)	32 ± 8	28 ± 10
	Preoperative	Postoperative*
Per Cent > ideal	125 ± 32	55 ± 34†
Per Cent excess weight lost	—	57 ± 20†

* Mean followup 20 ± 10 months.

† Eight patients were excluded from these data: four because they had significant postphlebitic edema, four because they were not yet beyond the sixth postoperative month.

Exhaustive dietary counseling was carried out before operation by the investigator, both to determine the understanding of the operation and likelihood of compliance by the patient, and to prepare the patient for the marked dietary changes that are essential in every patient for adequate weight loss. Principles stressed included 1) cessation of eating when the patient is no longer hungry, 2) three small well-balanced meals per day, 3) no liquids with meals, 4) waiting five minutes between bites of solid food to allow thorough chewing, and 5) total avoidance of high calorie liquids.

Sixty-nine patients underwent a standard stapled loop gastric bypass[9] after mechanical bowel preparation, parenteral cephalosporin, and subcutaneous heparin (5,000 units every 12 hours) beginning the evening before operation. Subcutaneous portions of the wounds were packed open with moist gauze dressings. After operation, parenteral antibiotics were continued until feeding, at which time they were administered orally. Upon resumption of enteric function, nasogastric suction was discontinued, and liquid feedings were begun. As tolerated, a regular solid diet (small portion) was given. Patient's were discharged from the hospital after a minimum of two days on the solid diet, in order to ensure compliance and absence of vomiting. Medications to be continued after discharge from the hospital included therapeutic multivitamins in all cases.

After operation, patients were examined monthly for six months, then bimonthly for six months, and quarterly during the second year. Bimonthly, or as needed, a complete blood count, prothrombin time, serum glucose, serum creatinine, electrolyte, protein, albumin, magnesium, bilirubin, transaminases, and alkaline phosphatase levels were obtained.

Before operation, and at any contact after operation, a standard questionnaire was completed by the patient, and historic data and laboratory results were stored in a PDP 1134 minicomputer. Data storage, retrieval, and statistical routines were written in the MUMPS language.

Patients were readmitted to the hospital for complete evaluation between 12 and 18 months after operation, at which time the studies obtained before operation were repeated.

The first ten patients also underwent upper gastrointestinal panendoscopic examination and percutaneous liver biopsy. Panendoscopic examination was carried out using local anesthesia to the posterior pharynx and using intravenous diazepam sedation. The Olympus® GIF-P2 pediatric endoscope was used because of the small pouch size. The esophagus and stomach were evaluated for evidence of inflammation and for evidence of reflux of bile into the stomach or of gastric contents into the esophagus. Biopsies of the distal esophagus and stomach were obtained routinely. The greatest diameter of the stoma was estimated using the open biopsy forceps (5 mm) as a reference. An attempt was made to enter the stoma and evaluate the jejunum in all cases.

Thirty patients had upper gastrointestinal series ten months or more after operation (mean 17.4 ± 6 months), and measurements of the proximal pouch and stoma were obtained.[9] Linear regression analysis (by the method of least squares) was carried out to determine the relationship between pouch size and weight loss.

Liver biopsies were obtained percutaneously and were evaluated for fibrosis, steatosis, inflammation, anisocytosis and cholestasis on a point basis ranging from 0–4 (10).

Patients were readmitted to the hospital when medical problems occurred, and further extensive dietary counseling was provided by the investigator and dietician as needed, to both in-patients and to out-patients.

TABLE 2. *Operations Performed at Time of Gastric Bypass*

	Number of Patients	Per Cent
Gastric bypass	69	100
Caval clip	57	83
Liver biopsy	56	81
Gastrostomy	47	68
Appendectomy	38	55
Cholecystectomy	14	20
Splenectomy	9	13
Tubal ligation	3	4
Reanastomosis of intestinal bypass	3	4
Closure of gastroplasty	1	1
Hernia repair	2	3

Results

Sixty-nine obese patients were selected to undergo gastric bypass (GAB). The patients were morbidly obese (Table 1), with the average patient being 125 ± 32% (mean ± SD) greater than ideal weight (Metropolitan Life Insurance Company). Twelve of the patients (six men) were selected for operation despite lesser weights (mean: 82% greater than ideal) because of difficulty that their obesity caused in obtaining work or holding a job. The data in this report were evaluated at a mean of 20 ± 10 months after operation (range: 3–40 months).

Additional Surgical Procedures (Table 2)

Following a death from pulmonary emboli, and two deaths from distal pouch dilation and perforation, prophylactic placement of a nonocclusive caval clip and a Stamm gastrostomy have been made a routine part of the operation. The last 47 patients have had the gastrostomies, and caval clips were successfully placed in 57 of the last 59 patients without complications. The clip was placed just inferior to the duodenum, with no attempt made either to place it flush with the most inferior renal vein or to ligate either gonadal vessel. Since these additions to the operation were made 30 months ago, there has been no death (47 consecutive patients), and neither pulmonary emboli nor distal pouch perforation have occurred. However, two patients had sufficient retroperitoneal obesity to preclude safe placement of the caval clip. One of these patients was readmitted to the hospital several weeks after operation with multiple pulmonary emboli.

Prophylactic gastrostomy in the distal pouch has been totally successful in preventing perforation of the distal pouch, although two patients who underwent gastrostomy have developed marked dilation of the distal pouch after the gastrostomy was clamped, and have required temporary gravity drainage. The distal pouch obstruction (in the total of four patients who have developed it) was at the pylorus, demonstrated at autopsy in one patient, at reoperation in two patients (Table 3), and radiographically in the fourth patient (Fig. 1).

Additional operations carried out at the time of GAB are seen in Table 2. Fourteen patients (20%) were found to have cholelithiasis before operation and had elective cholecystectomy at the time of bypass. Splenectomy was performed out in 13% of the patients, either because of a capsular tear or because the proximity of the spleen to the stomach would have made the bypass impossible.

Weight Loss

At 20 months (mean) follow-up, patients had lost weight from 125% (mean) above their ideal weights to a mean of 55% above ideal. This represented a loss of 57% of excess weight (Table 1). Ninety per cent of our patients lost at least half of their excess weight.[9]

TABLE 3. *Reoperation Required after Gastric Bypass in Eight of 69 Patients (Four were Routine Cholecystectomy)*

	Time After Operation	Number	Per Cent	Result
Cholecystectomy	22	4	5.8	recovered
Revision of bypass	1) 1 wk 2) 20 mo	2*	2.9	1) premature plateau 2) losing weight
Replace gastrostomy	1 wk	1*	1.4	recovered
Patch leak, prox pouch	1 wk	1	1.4	jejunal patch—recovered
Adhesiolysis	29 mo	1*	1.4	recovered
Subtotal gastrectomy (perforation distal pouch)	1 wk	1	1.4	died
Total related to bypass	—	4	5.8	

* Patient #25 required 3 operations.

Operative Complications

Table 4 summarizes the operative complications seen. The wound infection rate was 3%, and while 53% of patients had a temperature greater than 38 C (orally) at some time following operation, only two patients (3%) had clinical evidence of pneumonia. Mild urinary tract infections occurred in 18% of patients, all having required urethral catheterization after operation.

Late Technical Complications Related to the Pouch

Complications related to the gastric pouch and stoma were minimal. No anastomotic leaks occurred, but two patients developed small leaks of the proximal gastric pouch. Two patients (3%) have required a revision of the operation. The first was reoperated one month after GAB for a functional gastric outlet obstruction at the stoma, although radiographically and on gross examination at operation, there was no anatomic obstruction. The gastrojejunostomy was made larger, surgically, and 30 months later, the patient has lost 39% of her excess weight. The second patient's revision was carried out 20 months after operation for staple line dehiscence (Table 3). This patient's weight loss had plateaued within two months of the bypass (at 20% weight loss). Restapling was followed by a resumption of weight loss, and he currently has lost 70% of his excess weight, nine months later.

Staple line dehiscence has occurred in a total of four patients, and clearly was related to "binge" eating and psychiatric disability in three.[9]

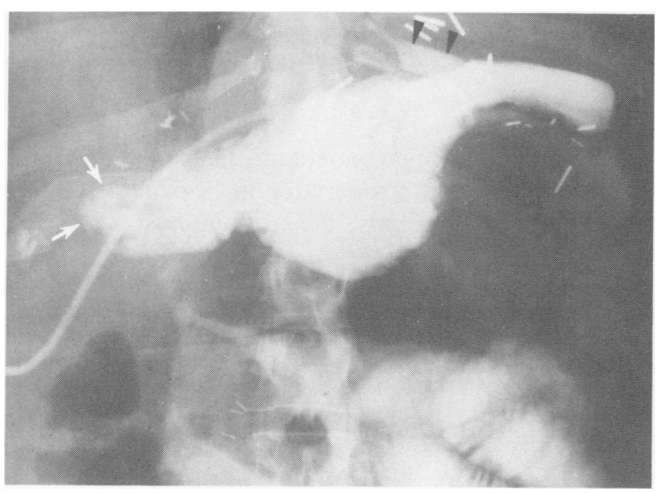

FIG. 1. Functional gastric outlet obstruction after gastric bypass. Orally administered contrast material opacified the small proximal gastric pouch (black arrows) and passed readily into the small bowel. Contrast was then introduced into distal stomach by gastrostomy tube and within 30 minutes had reached the distal antrum (white arrows) but not the duodenum.

TABLE 4. *Operative Complications in 69 Patients who had Gastric Bypass*

	Barnes (Per Cent)	Iowa (Per Cent)	Kansas (Per Cent)	N. Carolina (Per Cent)
Operative				
deep venous thrombosis	6.1	—	—	—
wound infection	3.0	13.5	4.3	1.9
splenectomy	13.0	2.2	5.5	5.2
subphrenic abscess	1.4	2.2	2.8	5.2
dehiscence	0	—	—	—
pneumonia	3.0	2.0	—	—
pulmonary embolus	2.8*	1.0	—	—
hernia	5.8	6.2	—	—
Pouch and stoma				
leak	2.8	4.0	2.5	3.9
ulcer	0	2.9	1.8	0.6
bile gastritis	0	1.0	0.3	0.6
obstruction	1.4	5.3	2.5	4.5
staple dehiscence	6.1	—	—	3.9
Deaths				
pulmonary embolus	1.4*	0.6	0.5	1.3
peritonitis	2.8*	1.8	1.0	—
late, unrelated	0	2.9	0.8	—

* Occurred before operative modifications described in text.

Rehospitalization and Reoperation

Rehospitalization for reasons related to the bypass was necessary in 14 (21%) patients (Table 5), nine of these patients having been readmitted primarily for failure to comply with the dietary regimen. In these patients, a normal upper gastrointestinal series suggested that the patient's symptoms were caused by incorrect eating habits, and intensive dietary counseling and regulated feedings (as an inpatient) alleviated the symptoms in all cases.

Reoperation for reasons related to the bypass was required in 5.8% of the patients (Table 3). Two patients (discussed above) have required revision. One of these, in addition, required replacement of a dislodged gastrostomy tube one week after bypass and 29 months later required adhesiolysis.

Subtotal gastrectomy was carried out in one patient who developed signs and symptoms of peritonitis one week after GAB. Laparotomy revealed massive dilation of the distal gastric pouch, with a normal duodenum and no evidence of obstruction of either the afferent or efferent jejunal loop. A gastrostomy had not been placed in this patient at the time of GAB. The fourth patient requiring reoperation was discussed earlier.

Metabolic Abnormalities

Metabolic abnormalities after GAB have been infrequent (Table 6), and in no case did the abnormalities

TABLE 5. *Rehospitalization After Gastric Bypass*

	Number of Hospitalizations	Number of patients	Per Cent	Months After Operation	Cause	Treatment	Result
Failure to empty pouch	1	1	1.5	1	unknown, normal UGI	enlarge gastrojejunostomy	early weight plateau
Subphrenic abscess	1	1	1.5	2	post splenectomy	catheter drainage	healed
Vomiting/abd. pain	6	5	7.6	5	rapid eating	behavioral modification	resolved
Acute abd. pain	1	1	1.5	7	1 cm dehiscence staple line	dietary counseling	further loss
Hypoglycemia	1	1	1.5	10	excess carbohydrate load	low carbohydrate frequent feedings	controlled
Cholelithiasis	5	5	7.6	17	—	cholecystectomy (4)	recovered
Outlet obstruction	1	1	1.5	18	inadequate chewing	gastroscopy normal	recovered spont. overnight
Weight gain	2	2	3.0	21	1. rapid eating 2. staple dehiscence	1. behavioral modification 2. restaple pouch	further loss
Psychosomatic symptoms	3	3	4.5	22	unknown	psychiatric	poor
Iron deficiency anemia	2	2	3.0	36	1. hemorrhoids 2. menometrorrhagia	symptomatic D & C	good good
Small bowel obstruction	1	1	1.5	29	adhesions	adhesiolysis	resolved
Total number patients: (related to bypass)	—	14	21				

which occurred threaten the patient. Hypokalemia was seen in 33% of patients, but nine of the 22 patients were on diuretics. The hypokalemia was seen within the first two months after operation (at the time of the lowest oral intake) in all patients, and persisted beyond the sixth month in only 14 (21%) of all the patients. All of the patients who became hypokalemic and were taking diuretics had been hypokalemic before operation. All patients were treated successfully with oral potassium supplementation.

Mild hypomagnesemia resolved spontaneously (four patients) or with magnesium supplementation (two patients) in all. One of these patients had mild hypomagnesemia (1.3 meq/l) before operation.

Postoperative hypovitaminosis was seen in up to 26% of patients, but in all cases was detected before the deficiency was clinically significant. Preoperative levels were normal in all of the patients with postoperative hypovitaminosis except for: vitamin A (one patient); folate (three of six patients); prothrombin time (one patient). Vitamin deficiencies were successfully treated after operation by either oral supplementation (vitamin A, folic acid) or by parenteral injection (vitamins B12 and K). Vitamin B12 deficiency was detected at (mean) 20 ± 11 months after operation, and folic acid deficiency at 13 ± 6 months.

Postoperative Anemia

Before operation, no patients were anemic, but mild anemia was seen after operation in 12 patients (18%). In five of these patients, the anemia was associated

TABLE 6. *Abnormalities Seen after Gastric Bypass*

	Criterion	Number	Per Cent	Mean Serum Level	Normal Range
Hypokalemia	<3.5 more than once	22	33	3.3 ± 0.1 mEq/L	3.5–4.5
Hypomagnesemia	<1.5 more than once	6	9	1.3 ± 0.16 mEq/L	1.5–2.4
Hypovitaminosis					
A	<30	12	18	22.3 ± 6.1 UG/DL	30–65
B12	<250	17	26	181 ± 45 PG/ML	250–1000
folate	<3	6	9	1.7 ± 0.6 NG/ML	3–15
K	<60% control prothrombin time	13	20	47 ± 11	60%
Anemia	<35% beyond sixth month	12	18	33 ± 1.8% (Hct)	37–47%
Low serum Fe	<80	13	20	55 ± 12 UG/DL	80–160

* None were clinically significant to the patient.

with iron deficiency (Table 6). Two patients reported postoperative blood loss (one had hemorrhoids, a second, menometrorrhagia), but in five patients (with guaiac negative stools), the anemia was of unknown origin.

Iron deficiency occurred in 20% of the patients, overall; only the five patients discussed above were anemic. Ten of the iron deficient patients had high or normal total iron binding capacity.

While all patients were placed on daily therapeutic multivitamins after operation, 15% reported (at their most recent office visit) that they were not taking the vitamins. Iron supplementation was required in 42% of the patients, overall, but 14 of these 27 patients were slightly anemic at the time they left the hospital, having sustained moderate blood loss at operation. Late treatment for iron deficiency was required in only 19% of patients, the deficiency, itself, having been detected at 17 ± 11 months after operation.

Postoperative Symptoms

Immediately after operation, all patients reported feeling full after just a little food, and all but one patient reported that their appetite had dramatically decreased. According to responses by the patients before operation, the mean number of meals eaten per day was 4.3 ± 1.3. The daily mean number of meals decreased after operation ($p < 0.01$). At the time of last contact, one-third of the patients were eating three or less meals per day, and 60% were eating four to six meals. Because of the emphasis placed on slow eating, all patients were asked (at each contact) how long they took to eat an average meal. The mean reported was 23 ± 9 minutes.

Vomiting has been an infrequent problem in this series of patients, and was negligible when the dietary instructions were carefully followed. Only 18% of patients vomited at any time in the hospital after operation. While 41% of patients did report some vomiting at at least two office visits, only 11 patients (16%) had vomiting persisting beyond the first three months after operation. These people vomited an average of 1.5 ± 1.2 times per day. Twenty-seven patients stated that high fiber meats caused emesis. Persistent bile emesis did not occur. Seven patients (10%) reported mild heartburn after operation, but only 8% of the entire group of patients began antacid therapy.

Endoscopic Evaluation

While nearly all patients had radiographic evidence of esophageal reflux at the time of their routine postoperative upper gastrointestinal series (a year or more after operation), none of the ten patients who underwent endoscopic examination had microscopic evidence of esophageal inflammation. Two of the ten, however, were seen to have mild erythema of the distal esophagus, grossly. Of these same patients, microscopic examination of a proximal gastric pouch biopsy specimens demonstrated mild inflammation, in two patients. Mild erythema of the pouch was seen, grossly, in one patient, and mild bile reflux was noted in one patient.

At gastroscopic examination, an attempt was made to enter and calibrate the outflow stomata in seven of the ten patients. Estimates of stoma size revealed that one patient had a stoma of 2 cm, and the other four patients measured (mean) 1.1 ± 0.2 cm. Of 39 upper gastrointestinal series reviewed at (mean) 20 months after operation, stoma dilation (stoma >1.5 cm) was seen in no patient; the mean (radiographically estimated) diameter was 0.8 ± 0.3 cm.

TABLE 7. *Comparison of Pre- and Postoperative Histologic Findings on Liver Biopsy*

	Preoperatively	Postoperatively
Fibrosis	0.30 ± 0.15	0.56 ± 0.18
Steatosis	2.10 ± 0.17	1.00 ± 0.44*
Inflammation	0.40 ± 0.16	0.44 ± 0.18
Anisocytosis	0.60 ± 0.12	0.72 ± 0.17
Cholestasis	none	none

Grading scale (10) of 0–4 was used. Other parameters showed no pre- or postoperative differences.
* $p < 0.05$.

Pouch Size

Proximal pouch size was also estimated radiographically, and correlated negatively ($p < 0.01$) with weight loss. That is, the more dilation of the proximal pouch that was measured on the upper gastrointestinal series after operation, the less of the excess weight was lost by the patient.[9]

Liver Biopsy

Percutaneous liver biopsy performed between 12 and 18 months after operation on the first ten patients revealed no significant change in the minimal amount of fibrosis, inflammation, and anisocytosis seen before operation, but revealed a statistically significant ($p < 0.05$) decrease in the steatosis (Table 7). This decrease is consistent with the return to normal levels (from minimal elevations before operation) of serum alkaline phosphatase and serum glutamic-oxaloacetic transaminase by the end of the second year after operation, seen in nearly all patients.

TABLE 8. *Pre- and Postoperative Responses by Gastric Bypass Patients to Office Questionnaire*

	Pre-operatively	Postoperatively	Per Cent
Work status	Working	Working	50
	Not working	Working	20
	Working	Not working but feel good enough	6
	Not working	Not working because feels too bad	6
	Not working	Not working	18
Satisfied with life?	Yes	Yes	26
	No	Yes	54
	No	No	20
	Yes	No	0

Life Style

After operation, the patients described definite changes in how they felt physically, how they felt about their lives, and how well they were able to function at work. When asked how they were feeling, 68% of the patients responded "much better," 29% "okay," and 3% "not better." At last contact, 17 patients (25%) reported feeling "tired all the time." However, six of these patients had episodic depression, six had not yet lost much weight, and one recently had delivered a baby. Of the remaining four patients who felt tired, three were employed fulltime, and one was caring for a housefull of children.

Gastric bypass has made an impact upon the ability of the patients to work. Of patients who were at least six months postoperative, 70% were working; another 6% were not, but felt good enough to work (Table 8). Half the patients were working before operation (and still were employed), but 20% are able to work now, whereas they were unable to hold a job before operation.

Within the first two years after GAB, 17% of the patients had either separated or had been divorced from their spouses. An additional four patients (6%) who were not married at the time of operation had become married.

All patients were asked both before and after operation whether they were satisfied with their lives. Twenty-six per cent of the patients who were at least six months postoperative said that they were satisfied with their life both before and after operation. Another 20% said no both before and after operation. But 54% of the patients had said before operation that they were not satisfied with their lives, but that they were satisfied after operation (at the last contact) (Table 8). The operation made no patients less satisfied with their lives.

Discussion

The selection of a patient for a gastric restriction procedure is a complex procedure which must weigh the morbidity and mortality rates incurred by the obesity[1] against the psychiatric status of the patients (and his/her ability to comply with rigid diet restriction[9,11], and which must exclude concomitant medical illness and endocrine causes of obesity. Over half the patients who desire such an operation do not meet one of the above requirements.[9]

Nonetheless, there is a small group of patients who are morbidly obese and who have made prolonged, properly supervised attempts at weight reduction for whom the operation represents a final chance to lose a large amount of weight, permanently, and to accrue the consequent medical and social benefits. The measurement of "success" of the operation, however, is difficult since it involves weighing the benefits of weight loss against the risks (both short- and long-term) of the operation, neither of which are well-defined.

The gastric bypass was chosen for this protocol since, in 1977, GAB was the oldest and technically best-defined gastric restriction procedure. Weight loss of 30–35% at one year had been described.[4,11–15] We have continued to do GAB because 90% of our patients have lost at least half of their excess weight.[9] Further, the many modifications of the gastroplasty operation produce a higher incidence of proximal outflow tract dilation or obstruction than GAB.[1]

As a result of the complications seen after jejunoileal bypass,[17,18] reanastomosis ("take-down") of the intestinal bypass with conversion to one of the gastric restriction procedures has become common.[19,20] It is our view, however, that most patients who require reanastomosis of the intestinal bypass require it because of serious complications, and the imposition of yet another major procedure upon the reanastomosis operation is unwarranted. Accordingly, only 6% of our GAB patients had take-down of a previous obesity operation at the time of GAB (intestinal bypass—three patients; gastroplasty—one patient). Without exception, these patients were not ill, but their operation had failed in that they had regained substantial weight.

Operative complications after GAB have been infrequent. Only four patients have had leaks of any kind. After two perforations due to pyloric obstruction, further distal gastric pouch leaks have been prevented by the use of a gastrostomy. The two other patients had small proximal pouch leaks which were not related to the gastrojejunostomies or to the major staple line. The cause of these perforations remains unclear, since acid production in the proximal pouch is mini-

mal.[21] However, no further proximal pouch leaks have occurred since we routinely started giving cimetidine after operation.

While deep venous thrombosis has occurred in 6% of our patients, pulmonary embolus has not occurred since we began using the modified DeWeese clip prophylactically on the inferior vena cava. The low incidence of wound infection probably is the result of allowing subcutaneous wounds to heal secondarily or of using, when possible, delayed primary closure.

Complications related to the proximal gastric pouch, to the staple line, and to the outflow tract (or stoma) are discussed elsewhere.[9] The low incidence of such complications compares favorably with a higher incidence after the various gastroplasty operations, where the incidence of reoperation is much higher,[15] and where late weight gain probably is seen more frequently because of dilation of the stoma (regardless of what steps are taken to prevent its dilation).

Due to bypass-related problems, 21% of the patients were readmitted to the hospital at some time in the first two years after operation. However, most of these admissions were related to deviation from the usual postoperative diet regimen. That is, the patients were eating too rapidly or were chewing inadequately, problems which we have found are best dealt with as an in-patient, with intensive diet counselling. All of these patients responded well to advancement from a liquid to a solid, carefully-timed diet (five minute intervals between bites) and were discharged without emesis after two to three days.

One of the principal advantages of any of the gastric restriction procedures over intestinal bypass is the relative absence of metabolic complications. Gastric restriction is effective because it produces early satiety; there is no malabsorptive component. There have been no long-term reports of serious metabolic abnormalities after any of the gastric procedures.

The electrolyte abnormalities which occurred in our patients first were observed within a few months of operation, at the time of lowest oral intake. Since the abnormalities were corrected easily by oral supplementation, we believe that the deficiencies were the result of inadequate intake rather than due to malabsorption or any other pathologic change which might have resulted from the operation. On the other hand, shunting the food stream around the duodenum produced iron deficiency in some patients.

Other reports have mentioned hypovitaminosis only anecdotally,[14] but we have documented vitamin dificiencies in up to one-fourth of our patients, despite daily oral multivitamin supplementation.

These data demonstrate the importance of postoperative oral vitamin supplementation and periodic monitoring of serum electrolyte and vitamin levels, particularly since 15% of the patients admitted that they were not taking their vitamins at their last office visit.

The absence of severe vomiting, bile emesis, marginal ulceration, and dyspeptic distress, in our patients, contrasts with earlier reports.[5,14] Vomiting has been an infrequent problem, and when it occurred, has always been corrected by modification of the eating behavior.[9] While earlier reports[5] describe frequent bile emesis after GAB, its absence in our patients is probably due to the consistently small (1 cm) outflow tract, which also obviates the need for a Roux-en-Y gastrojejunostomy.[13,22,23] Similarly, the smaller proximal pouch size of today's operations minimizes the amount of acid to which the jejunum is exposed, and, thereby, the incidence of marginal ulceration. The absence of significant gastroscopic findings in this regard was encouraging.

Our experience with postoperative percutaneous liver biopsy in the first ten patients has revealed an improvement in the morphologic status of the liver compared with preoperative biopsies. This is in stark contrast to the hepatic dysfunction seen in almost all patients after intestinal bypass[17] and remains one of the primary reasons for abandonment of that operation in favor of the various gastric restriction procedures.

A recent report has shown that patients who lose large amounts of weight after GAB "feel better about themselves" after operation.[24] In general, patients in our series feel very good, and the persistent fatigue, present so commonly after intestinal bypass[18] is unusual. Seventy-six per cent of the patients who have passed the sixth postoperative month mark are working. Moreover, 20% of our patients who could not work before operation, (usually due to either physical limitations related to obesity or to employer attitude) are now employed.

Eighty per cent of the patients are now satisfied with their lives, compared with 26% before operation. Most importantly, over half of our patients claim that the operation has changed their previously unsatisfactory lives to satisfactory ones. While the significance of this response to a subjective question is unknown, the response probably reflects the patient's perception that the bypass has had a positive effect.

To determine whether there was justification for operative intervention in this group of morbidly obese patients, we must compare the massive, prolonged weight loss they experienced with the low incidence of dangerous complications and with the apparent improvement in quality of life. We conclude that gastric

bypass, in properly selected patients, produces sufficient weight loss in most patients to justify the operation. If follow-up is complete and long-term, the late metabolic complications and weight gain will be minimal.

These results contrast with available data from other gastric restriction procedures, and until further data which demonstrate superiority of those operations are made available, it is our opinion that the gastric bypass should remain the procedure of choice for morbid obesity.

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