Gastrointestinal malabsorptive procedures

J Patrick O'Leary

ABSTRACT Morbid obesity is a complex disease, the etiology of which is clearly multifactorial. The weight loss produced by intestinal shunting procedures has been profound and the etiology of the weight loss is clearly more complex than rapid intestinal transit and gross malabsorption of foodstuffs. The best known surgically produced malabsorptive procedure for the treatment of morbid obesity is the jejunoileal bypass. This procedure produces substantial weight loss but has been associated with late postoperative complications that make its use problematic. Other procedures (biliary bypass, biliopancreatic diversion, and long limb Roux-en-Y gastric bypass) have not been associated with liver dysfunction. Varying degrees of malnutrition are frequently associated with these procedures. Careful study of the patients with these procedures is warranted. *Am J Clin Nutr* 1992;55:567S–70S.

KEY WORDS Obesity, surgical treatment of obesity, malabsorptive procedure, jejunoileal bypass, biliopancreatic bypass, biliopancreatic diversion, long limb Roux-en-Y gastric bypass, biliary bypass

Introduction

Surgical intervention in the treatment of morbid obesity began in the early 1950s when several different groups proposed procedures that shortened the gastrointestinal tract, thereby producing substantial decreases in the absorptive area exposed to ingested food. Surgeons based this approach on observations made in patients who had massive small bowel resections and experienced weight loss followed by weight stabilization. These patients had decreased intestinal transit time, diarrhea, malabsorption, and in some individuals, malnutrition. It is not clear who should receive credit for having performed the first of these procedures in the obese patient, but the first recorded mention of such a procedure occurred at a meeting of the American Surgical Association in 1954 (1).

For the purposes of this discussion, data will be presented about the procedures that affect the absorption of nutrients from the gastrointestinal tract by either shortening the absorptive area, interfering with the admixture of food and facultative enzymes, or a combination of both. It should be noted that gastric restrictive procedures that bypass the duodenum (gastric bypass) may also produce a certain degree of malabsorption (calcium, iron, magnesium, and changes produced by a decreased release of gut peptides cholecystokinin, secretin, glucagon, etc.). The effects of such peptide changes have not been exhaustively studied.

Between January 1986 and midyear 1990, there were 35 articles published dealing with the intestinal bypass (JIB) and 11 articles that dealt with biliopancreatic diversion (BPD). Of the JIB articles, 8 of 35 were published from US sources. Most of these dealt with either late results or a specific complication of the procedure. Review of the remaining articles, predominantly from Europe, suggested that ongoing series were still being accumulated. Under the category of BPD, only 2 of 11 articles were from the United States, with both of these articles being published by the same group. Of the remaining articles, one was from Canada and the remainder were from Europe. Six were from Scopinaro's group in Genoa.

Intestinal bypass procedures

The intestinal bypass procedures shunt ingested food from the jejunum at a point 36 cm distal to the Ligament of Treitz, into the ileum or the colon, thus bypassing the majority of the small intestine (Figs 1 and 2).

In the Kremen (1) paper, the patient described had undergone a JIB. In the discussion of the paper, Sandblom described a procedure performed by Henriksson in Sweden. In this patient, a resection of the midportion of the small intestine had been performed. It was unclear from the report how much of the small intestine was left intact. Although weight loss was produced, Sandblom stated that it "created a difficult situation of nutritional balance."

The first series of patients was described by Payne et al in 1963 (2). A jejunocolic shunt (JCS, 36 cm ileum connected to the transverse colon) was performed in 10 patients. The remainder of the small intestine was left functionally within the abdominal cavity. Although weight loss was produced, these patients developed many problems with electrolyte imbalance and diarrhea. Rehospitalization was the rule. One of the most important aspects of this study occurred after the patients had reached stabilization at an acceptable weight. Six of these patients had their shunt taken down and normal intestinal continuity was reestablished. All six patients gained weight back to or above their preoperative level. Three remaining patients had their JCS modified to an end-to-side jejunoileostomy (JIB). In one of these patients, profound weight regain was ascribed to the large amount
of jejunum left in continuity. The other two patients maintained their weight loss with 36 cm of jejunum anastomosed to the side of the ileum, 10 cm from the ileoceleal valve. By 1967, Payne and DeWind (3) recommended against the JCS and suggested that the JIB (end-to-side jejunoileostomy) was the more appropriate procedure. Two years later, Scott et al (4) described a modified technique by performing an end-to-end jejunoileostomy and decompressed the bypassed small intestine into the colon.

At least 40 different series have been published from 1963 to 1980 by surgeons predominantly from the Western Hemisphere dealing with JIB. Generalizations taken from these studies are as follows: 1) Weight loss was excellent. 2) Patient satisfaction was generally good. 3) Psychosocial adjustment was satisfactory. 4) Early postoperative complications could be minimized (wound infection rate, 3%; operative mortality, 0.5%). 5) All patients developed diarrhea. 6) Electrolyte imbalance could be controlled. 7) Approximately 50% of patients developed some type of late metabolic complication. 8) Previously unsuspected late metabolic complications such as liver failure, nephrolithiasis, autoimmune arthritis, nephritis, and skin disease occurred in up to 20% of patients. 9) Complication could first appear long after the procedure (> 10 y).

Although jejunoileal bypass is still being performed in certain countries, in the United States its application to patients with morbid obesity has become quite restricted. The complications that may occur long after the procedure have shifted the risk-benefit ratio so that the benefits of the procedure are outweighed by the risks of the procedure. Other operations that produce a lesser degree of malabsorption may have a role in treating certain selected patients with severe obesity.

**Biliopancreatic diversion**

By 1973, Scopinaro in Genoa modified the intestinal bypass and combined some of the principles learned from gastric-restrictive procedures with those learned from bypass procedures. He performed a subtotal gastrectomy leaving a small upper gastric remnant (volume: 100–400 mL). The small intestine was divided at its midpoint and the distal (ileal) end was anastomosed to the stomach. He then spliced the jejunal end of the divided small intestine to a point 50 cm proximal to the ileoceleal valve (Fig 3). In 1976, after an extensive experience in animals, Scopinaro applied this operation to morbidly obese individuals.
In 1979, he reported his results in 18 patients followed for a minimum of 14 mo (5).

Subsequently, this group has modified the size of the gastric pouch and the lengths of the intestinal limbs to minimize complications. In heavier patients (super obese: > 220% of ideal body weight) they have recommended a 200-mL gastric pouch. In lighter weight morbidly obese individuals, they have made the pouch 400 mL. Presently, Scopinaro divides the intestine 250 cm from the ileocecal valve. The distal end (ileum) is anastomosed to the gastric remnant. The excluded limb of intestine, which carries the bile and pancreatic excretion, is anastomosed to the side of the distal ileum 50 cm from the ileocecal valve. In 400 consecutive patients (operated upon from 1984 to 1988) weight loss has been good. No patient has lost < 50% of their initial excess body weight. Weight loss has been maintained. The early mortality rate has been 1.3%, with an overall early complication rate of 2.6%. Late complications in these patients have included anemia (< 5%), marginal ulcer (< 3%), protein malnutrition (10%), and peripheral neuropathy (< 1.3%).

Recent data from two US studies have suggested that the incidence of protein malnutrition may be slightly higher (approaching 20%) than in the Holian study (6). (M Clare, DK Holian, personal communication, 1991.) The measurements of the alimentary tract and common channel used in these studies have varied. Most complications were controlled medically. Some patients required revision of the procedure by elongation of the common limb or movement of the enteroenterostomy. The most common cause of reoperation has been malnutrition. It should be noted in these patients that liver failure has been seen infrequently, if at all. Routine liver biopsies have not demonstrated the development of those findings felt to be the prodrôme of cirrhosis (7). (E Gianetta, personal communication, 1984.) The incidence of autoimmune disease has also been rare. The incidence of nephrolithiasis, although increased over control levels, has been substantially less than that seen after JIB.

The BPD produces substantial and predictable weight loss. When compared with gastric partition or gastric bypass, weight loss is more predictable and probably of a greater degree. Proponents of the BPD state that weight regain has been shown to be less likely than after any of the other gastric stapling procedures. The most important complication occurring after this procedure is protein-calorie malnutrition, which when it occurs often occurs within the first 12 mo after the procedure. The role of this procedure in the treatment of morbid obesity will await further studies of larger numbers of patients from different locales studied over a protracted period of time.

Other procedures

Halberg (8) described a small series of patients in whom an end-to-side jejunoleal bypass had been performed. Instead of leaving the blind limb of intestine free in the abdominal cavity, he anastomosed the proximal end of this limb to the dependent portion of the gall bladder. This allowed bile to flow through the otherwise unused intestine. The number of patients in this series was small, but weight loss was excellent, diarrhea was uncommon, and liver failure did not occur.

A number of different authors have also modified the gastric bypass procedure by making the upper gastric pouch small (< 50 mL volume) and making the Roux-en-Y limb long. This differs from the bilipancreatic bypass in that the distal stomach is left in situ and the portion of the small intestine that makes up the alimentary canal includes jejunum instead of ileum. Absorption from the jejunum and the release of various intestinal peptides would appear to be different than that observed in patients with the BPD. No consensus has yet been reached regarding lengths of the Roux limb or the common channel for such procedures. It should also be noted that the vast majority of these modifications have been presented in oral form and rarely have results appeared published in the literature.

Questions to be answered

In Kremen's original report, the major thrust was an attempt to elucidate the differences in absorptive capabilities between the jejunum and ileum in an animal model. An additional portion of this study dealt with the potential of the intestine to adapt when transposed from one position in the alimentary tract to another position. Thirty-six years later, and with an experience of operations performed in > 100 000 patients, no clear answer has surfaced. It would appear that in the absence of bile and pancreatic secretions, the ileum does a poor job of absorbing fats, and to a lesser degree, proteins and carbohydrates. The jejunum probably does a better job of protein absorption, but no control studies have proven this point. Although empirical knowledge would suggest that the amounts of intestinal peptides released when the ileum is anastomosed to the stomach would be different when the jejunum is spliced to the stomach, this point has not been proven. Studies looking at the concentrations in serum of these hormones have been performed for the BPD, but these have been static studies, and we know nothing of the kinetics of release, rate of degradation, or effect of these agents on absorption (9). Intestinal hypertrophy and hyperplasia occur, but the agent(s) responsible for these processes remains unknown.

There may be a substantial correlation between recent theories of bacteria translocation in the small intestine of patients with hypoperfusion states and the long-term effect seen in patients with a defunctionalized limb of intestine left within the abdominal cavity. In our laboratory, several studies suggested that bacterial overgrowth in the excluded limb of intestine was associated with the production of a hepatotoxin (type uncharacterized) that damaged the liver in patients with a JIB (10, 11). This may be a variant of the bacterial translocation theory that has been studied extensively within the past two years in subjects with multiple organ system failure. Other explanations may include alterations in the availability of glutamine at the mucosal-luminal interface, decreased availability of glutamine or glutaminase to the peri-portal population of hepatocytes, uncoupling of the urea cycle, or a lack of biliary immunoglobulin A within the excluded limb of intestine.

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References