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Minimally invasive surgery for morbid obesity

ABSTRACT

In patients with morbid obesity, surgery is the only treatment known to produce sustained weight loss and to reduce comorbidities. Traditional (open) gastric bypass surgery is associated with postoperative complications that include wound infection, pulmonary embolism, and pneumonia. Laparoscopic techniques achieve similar long-term results as does open surgery, with fewer postoperative complications.

KEY POINTS

Surgery produces better results than medical therapy in terms of keeping weight off in the long term and resolving comorbidities associated with morbid obesity.

Laparoscopic gastric bypass surgery is less invasive than open surgery, and it offers similar long-term results.

After surgery, patients are prone to nutritional deficiencies and metabolic complications and require regular medical follow-up.

MORBID OBESITY can now be treated with less-invasive laparoscopic surgery. The new technique appears to be as effective as conventional open surgery in taking weight off and keeping it off.

This paper reviews the rationale, techniques, and relevant statistics for laparoscopic bariatric surgery.

CONSEQUENCES OF MORBID OBESITY

Morbid obesity is defined as a either a body mass index (BMI) of 40 kg/m^2 or higher, or a BMI of 35 or higher with associated comorbid conditions such as pulmonary insufficiency, hypertension, or diabetes.[1]

Except at the extreme low end of the scale, mortality risk rises with weight. People who are morbidly obese have more than twice the risk of death compared with people in the desirable weight range (BMI 18.5–24.9 kg/m^2).[2,3] In addition, morbid obesity is associated with a staggering increase in serious medical problems, for example:

- Hypertension—59% prevalence, with an increased risk of stroke, coronary artery disease, and arrhythmias[4]
- Type 2 diabetes mellitus—33% prevalence,[5] and the level of glucose intolerance is directly related to the amount of excess weight
- Cholelithiasis—three times greater incidence than in nonobese people
- Cancers of the breast, colon, and uterus—greater incidence than in nonobese people
- Infertility, amenorrhea, wound infection, and venous stasis disease—all increased
- Arthritis and back pain—up to 60% prevalence
- Significant respiratory problems—com-

mon, including the hypoventilation syndrome of obesity, sleep apnea, and reactive asthmatic bronchitis.[6]

Perhaps as disabling as the multiple physical problems in these patients is a high prevalence of psychiatric problems, including depression, low self-esteem, and physical and sexual abuse. Social ostracism and employment discrimination are common.

WEIGHT-LOSS THERAPY IS NEEDED

Safe and effective weight-loss therapy is needed, as approximately 10 million Americans are morbidly obese, and the number is increasing alarmingly.

Other therapies such as diet, behavior modification, exercise, drugs, or even jaw-wiring have consistently failed to control this disease.[7] At best, strictly monitored diets produce minor weight loss over a 2-year period, and the lost weight is quickly regained as soon as dietary restrictions are removed.[8] Drug therapy with phentermine can cause long-term cardiopulmonary problems.

EARLIER SURGICAL PROCEDURES

Intestinal bypass

Early bariatric surgical procedures induced weight loss by malabsorption, ie, by decreasing the absorptive surface of the intestine.

Kremen et al[9] performed the first intestinal bypass via jejunoileostomy in 1954, and Payne and DeWind[10] performed a distal jejunocolonic anastomosis in 1956. These procedures were later modified by Sherman et al,[11] who sutured 14 inches of proximal jejunum in an end-to-side fashion to the terminal ileum 4 inches proximal to the ileocecal valve.

Effectiveness. Patients who underwent jejunoileal bypass lost an average of 35% of their body weight in 1 year, and those who underwent jejunocolonic anastomosis lost 41%.[11,12] The loss was greatest during the first year and remained constant over 5 to 10 years.

Complications. However, both procedures produced a 50% rate of severe complications, including diarrhea, liver failure, renal stones, gallstones, and vitamin B_{12} deficiency.

Bypassing most of the terminal ileum significantly decreases the absorptive capacity for sodium chloride, bile salts, and vitamin B_{12}. Only the ileum and colon actively absorb sodium chloride against steep electrochemical gradients. Although adaptive hyperplasia occurs in other regions of the small intestine, the absorptive qualities of the terminal ileum cannot be replicated.[12]

Subsequently, secretory diarrhea developed in most patients, with 20 or more bowel movements per day. This frequency usually decreased to about 6 to 10 per day when cholestyramine was given.

Furthermore, higher concentrations of intraluminal long-chain fatty acids were transported to the proximal colon, leading to saponification of intraluminal calcium with increased colonic absorption of oxalate. Hyperoxaluria developed, causing an increased incidence of kidney stones.

Hepatic insufficiency developed due to endotoxins produced by bacteria in the bypassed bowel and to increased fat deposition within the liver.[12] In addition, lipoprotein synthesis decreased as malnutrition worsened. Lipoproteins are necessary for hepatic lipid transport; with less lipoprotein available, more lipid is trapped within hepatocytes. Hepatic failure developed in 2% to 4% of patients. Half of patients in whom liver failure developed subsequently died.[13,14]

Owing to the high rate and severity of complications, approximately 23% of patients who underwent these initial bypass procedures needed to have the procedure reversed.[13]

10 million Americans are obese, and the number is rising

Gastric bypass

To avoid the high rate of complications associated with intestinal bypasses, Mason and Ito[14] devised a gastric bypass procedure for morbid obesity in 1966, after noting the loss in weight that occurs after gastric resection for peptic ulcer disease. Initially, they transected the stomach horizontally and performed a loop gastrojejunostomy to the proximal portion of the stomach.

This approach, modified numerous times,[15,16] is still performed and currently entails isolating the proximal gastric pouch with gastrointestinal staplers. Intestinal continuity is restored with a Roux-en-Y bypass instead of a loop gastrojejunostomy. A Roux-en-Y bypass is formed by dividing the jejunum

35 cm distal to the ligament of Treitz. The distal (Roux) limb is brought up to the gastric pouch. The proximal (Y or biliopancreatic) limb is re-anastomosed to the jejunum.[17]

Complications. Gastric bypass induces significant weight loss, but it also has postoperative mechanical and metabolic complications. Anastomotic leak occurs in 2.5% of cases, and stenosis occurs in 1.3%. Local wound infection occurs in 10% and requires operative debridement in 3.8%. Subsequent wound dehiscence occurs in 10% of patients. Postoperative incisional hernia develops in 16.2%. Metabolic alterations include deficiencies of vitamin B_{12}, iron, calcium, protein, and vitamins A, D, E, and K.[6]

THE LAPAROSCOPIC APPROACH

The laparoscopic surgical approach to morbid obesity was developed over the last decade to decrease postoperative pulmonary and wound complications.[18]

Now, more than 75,000 weight-loss procedures are performed each year. This number has significantly increased with the advent of laparoscopy.

Candidates must be morbidly obese and undergo nutritional, psychiatric, and endocrine evaluation

Candidates

The ideal candidate for laparoscopic bariatric surgery is morbidly obese and has not had prior abdominal surgery. Obese patients with a "pear" shape or a high hip-to-waist ratio are well suited for laparoscopic surgery.

To be eligible, patients must be morbidly obese and must undergo nutritional, psychiatric, and endocrinologic evaluation.

A nutritionist reviews with the patient the changes in diet that will be necessary after surgery. A thorough discussion of the dietary changes required after gastric bypass are beyond the scope of this summary, but changes typically include smaller meals with protein and vitamin supplements.

A psychiatrist looks for noncompliant behaviors such as drug or alcohol dependencies, which are contraindications for surgery.

An endocrinologist reviews the overall medical management of each patient, including diabetic and antihypertensive medications.

After consulting these three services, the patient is referred to a general surgeon, who performs a preoperative evaluation, reviews the surgical technique with the patient in detail, and discusses potential complications.

Complication rates

Patients who undergo laparoscopic bypass lose as much weight as those who undergo open bypass, but they recover faster and have smaller scars. More importantly, they have fewer wound complications such as infection, dehiscence, evisceration, and hernia. These occur in 40% or more of open bypass patients postoperatively.[19]

Other complications are also reduced. Pulmonary embolism occurs in 2% to 5% of patients after open surgery,[20] compared with 0 to 1% after laparoscopic bypass[21]; atelectasis occurs in 55% after open surgery[20] vs 5% after laparoscopic bypass.[21]

Laparoscopic technique

In the laparoscopic procedure, five small incisions are made, through which ports are inserted for abdominal access. The ligament of Treitz is identified initially, and the proximal jejunum is divided approximately 35 cm distal to this point. A jejunojejunostomy is performed with laparoscopic staplers.

A Roux limb of 150 cm is formed, and the mesenteric defect is closed to avoid postoperative internal hernias. The Roux limb is placed in an antecolic fashion. The stomach is divided with laparoscopic staplers to create a 20-cc pouch. The Roux limb is approximated to the pouch, and the anastomosis is tested with methylene blue for evidence of a leak. The ports are removed, and the skin incisions are closed.

Postoperative care

An upper gastrointestinal study with barium is obtained on the day after surgery to rule out an anastomotic leak. The patient is then started on a liquid diet free of caffeine, sugar, and carbonation and is discharged from the hospital as soon as the liquid diet is tolerated.

Long-term follow-up entails visits to an endocrinologist every 3 months for the first

year and twice a year thereafter. Surgical follow-up is at 1 week, 1 month, and 3 months postoperatively. Nutritional follow-up and psychiatric assessments are encouraged every 3 months as well.

SURGICAL RESULTS

As of March 31, 2003, 195 patients had undergone laparoscopic Roux-en-Y gastric bypass at The Cleveland Clinic. Of these, 36 (18.5%) required conversion to an open procedure. An additional 36 patients underwent open laparotomy without a laparoscopic attempt due to ventilatory problems during anesthesia induction or an extensive history of prior surgeries.

Complications

Anastomotic leak. Postoperatively, one anastomotic leak developed at the gastrojejunostomy. The patient had gone home on the 5th postoperative day, and the anastomotic leak was diagnosed 5 days later. The leak was controlled with a drain placed at the time of surgery. The patient began a regimen of antibiotics, intravenous fluids, and nothing-by-mouth for 5 days. A follow-up gastrograffin swallow test showed the leak had resolved without operative intervention. The patient has had no further complications.

A visceral leak occurred in one patient 3 cm distal to the gastrojejunostomy. This patient underwent surgical reexploration and oversewing of the enterotomy, was discharged home on the 5th postoperative day, and had no further complications.

Wound infections occurred in nine patients, all of whom had undergone open or converted bypasses.

Pulmonary embolism or deep venous thrombosis did not occur.

Other problems. One patient, with a BMI of 76 kg/m^2, had an evisceration that required a vicryl mesh repair, and another patient underwent splenectomy for a delayed rupture following a retraction injury. Two other patients underwent splenectomy intraoperatively due to retraction injuries. Five patients required reoperation for bowel obstruction, but all five have had excellent weight loss postoperatively.

Weight loss

By 18 months after surgery, the patients had lost an average of 35% of their baseline weight. The mean BMI decreased from 51.5 to 32.0 kg/m^2.

Hospital length of stay

Patients who underwent laparoscopic gastric bypass stayed a mean of 2.96 days after surgery, vs 5.11 days with open bypass and 4.08 days with laparoscopic conversion.

LONG-TERM FOLLOW-UP NEEDED

These data indicate that weight loss and complication rates for laparoscopic gastric bypass are consistent with those of open surgery, with fewer wound and pulmonary complications. These initial results are promising; however, this cohort requires long-term follow-up to determine excess weight loss and any future metabolic deficiencies or psychological disturbances. Only long-term follow-up will definitively validate the laparoscopic approach.

Regardless, the surgical results are significantly better than maximal nonoperative management. On the basis of these results, laparoscopic gastric bypass is a valid approach for the resolution of morbid obesity and its comorbidities.

Complications: leaks, stenosis, wound infection, dehiscence, metabolic complications

THE FUTURE

Experimental surgical techniques for the treatment of morbid obesity include neurosurgical manipulation of the satiety centers located within the brain. This technique avoids the potential complications of bypass surgery. However, cerebral manipulation engenders its own complications.

Another approach is to stimulate the stomach electrically. The mechanism of the weight loss has yet to be resolved. An initial trial verified the safety of electrical gastric stimulation: there were no deaths and exceedingly minimal morbidity. The US Food and Drug Administration has approved a second multicenter trial, which started in March 2002; this trial will evaluate the efficacy of the technique, which uses multiple leads and a variety of pacing parameters.

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