Bariatric surgery (Fig. 416-2) can be considered for patients with severe obesity (BMI, ≥40 kg/m^2) or for those with moderate obesity (BMI, ≥35 kg/m^2) associated with a serious medical condition. Weight loss surgeries have traditionally been classified into three categories on the basis of anatomic changes: restrictive, restrictive malabsorptive, and malabsorptive. More recently, however, the clinical benefits of bariatric surgery in achieving weight loss and alleviating metabolic comorbidities have been attributed largely to changes in the physiologic responses of gut hormones and in adipose tissue metabolism. Metabolic effects resulting from bypassing the foregut include altered responses of ghrelin, glucagon-like peptide 1, peptide YY3-36, and oxyntonodulin. Additional effects on food intake and body weight control may be attributed to changes in vagal signaling. The loss of fat mass, particularly visceral fat, is associated with multiple metabolic, adipokine, and inflammatory changes that include improved insulin sensitivity and glucose disposal; reduced free fatty acid flux; increased adiponectin levels; and decreased interleukin 6, tumor necrosis factor α, and high-sensitivity C-reactive protein levels.

Restrictive surgeries limit the amount of food the stomach can hold and slow the rate of gastric emptying. *Laparoscopic adjustable gastric banding* is the prototype of this category. The first banding device, the LAP-BAND, was approved for use in the United States in 2001 and the second, the REALIZE band, in 2007. In contrast to previous devices, these bands have diameters that are adjustable by way of their connection to a reservoir that is implanted under the skin. Injection of saline into the reservoir and removal of saline from the reservoir tighten and loosen the band's internal diameter, respectively, thus changing the size of the gastric opening. The mean percentage of total body weight lost at 5 years is estimated at 20–25%. In *laparoscopic sleeve gastrectomy*, the stomach is restricted by stapling and dividing it vertically, removing ~80% of the greater curvature, and leaving a slim banana-shaped remnant stomach along the lesser curvature. Weight loss after this procedure is superior to that after laparoscopic adjustable gastric banding.

The three restrictive-malabsorptive bypass procedures combine the elements of gastric restriction and selective malabsorption. These procedures are Roux-en-Y gastric bypass, biliopancreatic diversion, and biliopancreatic diversion with duodenal switch (Fig. 416-2). Roux-en-Y is the most commonly undertaken and most accepted bypass procedure. It may be performed with an open incision or by laparoscopy.

These procedures generally produce a 30–35% average total body weight loss that is maintained in nearly 60% of patients at 5 years. In general, mean weight loss is greater after the combined restrictive-malabsorptive procedures than after the restrictive procedures. Significant improvement in multiple obesity-related comorbid conditions, including type 2 diabetes, hypertension, dyslipidemia, obstructive sleep apnea, quality of life, and long-term cardiovascular events, has been reported. A meta-analysis of controlled clinical trials comparing bariatric surgery versus no surgery showed that surgery was associated with a reduced odds ratio (OR) risk of global mortality (OR = 0.55), cardiovascular death (OR = 0.58), and all-cause mortality (OR = 0.70).

Among the observed improvements in comorbidities, the prevention and treatment of type 2 diabetes resulting from bariatric surgery has garnered the most attention. Fifteen-year data from the Swedish Obese Subjects study demonstrated a marked reduction (i.e., by 78%) in the incidence of type 2 diabetes development among obese patients who underwent bariatric surgery. Several randomized controlled studies have shown greater weight loss and more improved glycemic control at 1 and 2 years among surgical patients than among patients receiving conventional medical therapy. A retrospective cohort study of more than 4000 adults with diabetes found that, overall, 68.2% of patients experienced an initial complete type 2 diabetes remission within 5 years after surgery. However, among these patients, one-third redeveloped type 2 diabetes within 5 years. The rapid improvement seen in diabetes after restrictive-malabsorptive procedures is thought to be due to surgery-specific, weight-independent effects on glucose homeostasis brought about by alteration of gut hormones.

The mortality rate from bariatric surgery is generally <1% but varies with the procedure, the patient's age and comorbid conditions, and the experience of the surgical team. The most common surgical complications include stomal stenosis or marginal ulcers (occurring in 5–15% of patients) that present as prolonged nausea and vomiting after eating or inability to advance the diet to solid foods. These complications typically are treated by endoscopic balloon dilation and acid suppression therapy, respectively. For patients who undergo laparoscopic adjustable gastric banding, there are no intestinal absorptive abnormalities other than mechanical reduction in gastric size and outflow. Therefore, selective deficiencies are uncommon unless eating habits become unbalanced. In contrast, the restrictive-malabsorptive procedures carry an increased risk for micronutrient deficiencies of vitamin B_{12}, iron, folate, calcium, and vitamin D. Patients with restrictive-malabsorptive procedures require lifelong supplementation with these micronutrients.

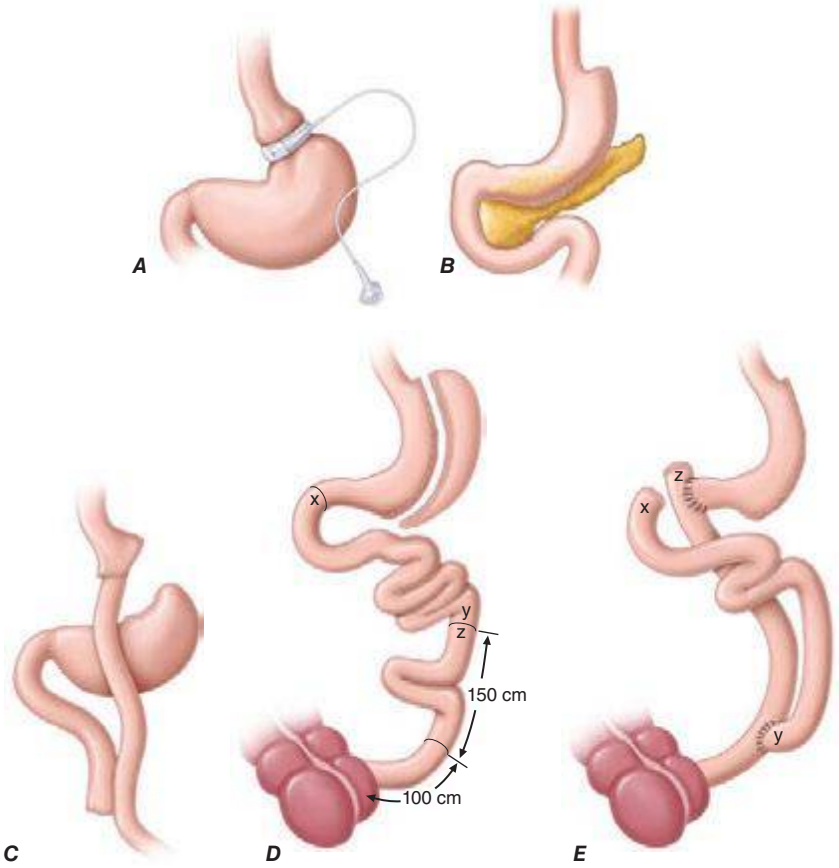

FIGURE 416-2 Bariatric surgical procedures. Examples of operative interventions used for surgical manipulation of the gastrointestinal tract. ***A.*** Laparoscopic adjustable gastric banding. ***B.*** Laparoscopic sleeve gastrectomy. ***C.*** The Roux-en-Y gastric bypass. ***D.*** Biliopancreatic diversion with duodenal switch. ***E.*** Biliopancreatic diversion. *(From ML Kendrick, GF Dakin: Mayo Clin Proc 815:518, 2006; with permission.)*