

Complications in bariatric surgery

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ABSTRACT

Bariatric surgery is one of the fastest growing hospital procedures performed in the world and is also an important option for patients with extreme obesity and co-morbidities. Bariatric surgery, however, involves risks and complications. Complications following surgical treatment of severe obesity vary based upon the procedure performed, and rate can be as high as 40 percent. Due to high surgical volume, improving the safety of these operations has become a high priority, leading to development of strict criteria for center accreditation, guidelines for safe and effective bariatric surgery, and careful monitoring of surgical outcomes. This report is a review of major complications of bariatric surgery.

Keywords: Bariatric surgery; complications; obesity surgery.

Introduction

Obesity is now a worldwide epidemic associated with both physical and psychological morbidity. Bariatric surgery has proven to be the most effective method of treating severe obesity. Positive effects have been demonstrated in clinical studies with longterm follow-ups regarding excess weight loss, control of comorbidities, decrease in mortalities associated with obesity and improvements in the quality of life.

As the number of bariatric operations increases, the complications arising from these procedures increase accordingly. Nevertheless, the acceptance of bariatric surgery is still questioned by the community not recognizing obesity as a disastrous disease. This prejudice is reinforced when severe complications arise from surgery and is enhanced by the occurrence of mortality, given that relatively young and healthy individuals are often subjected to surgery.

The risk of complications and mortality is associated with

certain controllable factors common to other patients and procedures, including older age, presence of associated systemic diseases, prior surgeries, experience of the surgeon, volume of the center, experience of the institution concerning ability to make early diagnosis and intervention.

On the basis of the published clinical series of bariatric surgery, the complications can be classified, as perioperative (up to 30 days after the operation); immediate postoperative (up to 6 months) and late (after 6 months). In addition, based on the severity of the complication, it can be classified as major (requiring reoperation or resulting in death) and minor.

Peri- and Postoperative Complications

Fistula or Leaks

According to the United Kingdom Surgical Infection Study



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Group, a gastric leak is defined as “the leak of luminal contents from a surgical join between two hollow viscera”. It can also be an effluent of gastrointestinal content through a suture line, which may collect near the anastomosis, or exit through the wall or the drain.^[1] Leaks can be classified based either on the time of onset, clinical presentation, site of leak, radiological appearance or mixed factors. Cendes et al. have defined early, intermediate and late leaks as those appearing 1 to 4, 5 to 9 and 10 or more days following surgery, respectively.^[2] Regarding the clinical relevance and extent of dissemination, leaks can be divided into two types. Type I or subclinical leaks are those that are well localized without dissemination into pleural or abdominal cavity and without any systemic clinical manifestation, usually easy to treat conservatively. Type II is leaks with dissemination into abdominal or pleural cavity, or the drains with consequent severe and systemic clinical manifestations.^[3]

Based on the data of 12799 laparoscopic sleeve gastrectomies of the International Sleeve Gastrectomy Expert Panel Consensus Statement 2011, the leak rate was 1.06%, but the leak rate can vary between 1% to 3% for the primary procedure and more than 10% in revision procedures.^[4–6]

Leaks after bariatric surgery can be due to mechanical or ischemic causes. Stapler misfiring, improper choice of the size of stapler’s height, and direct tissue injuries are mechanical causes of leaks usually appearing within two days after surgery. However, ischemic causes usually appear on day 5–7 postoperatively.^[7,8] Ischemic leaks mostly result from improper vascularization due to aggressive dissection, thermal injuries and inadvertent stapler usage. Other mechanical causes which end with late leaks are distal obstructions and stenosis, intraluminal hypertension, twisted gastric pouch, and narrowing at the angularis incisura.

In order to prevent leaks, some authors advocate gentle handling of tissues, staple line reinforcement, staple line oversewing, fibrin sealants, nasogastric tube placement for 24 hours postoperatively, larger bougie size, intraoperative methylene blue test or endoscopic air leak test.^[9–16] In revisional surgery, taking into consideration the stomach wall thickness due to fibrosis and choosing appropriate size of the stapler’s height will prevent possible leaks.^[17]

Early detection of the leakage is critical in a better outcome of the patient and high index of suspicion is the cornerstone.^[18] Clinical presentation can vary between as-

ymptomatic patients to the signs and symptoms of a septic shock including fever, abdominal pain, peritonitis, leucocytosis, tachycardia, and hypotension.^[19] The appearance of the draining fluid (pus, bilious, enteric) or extravasation of dye administered orally (methylene blue test) are also a presentation of the leak in patients to whom a drain is placed during surgery. Laboratory studies are neither sensitive nor specific but mostly contribute to the diagnosis. Computed tomography with IV and PO contrast is considered to be the best imaging modality for the detection and confirmation of a gastric leak with a detection rate of 86%.^[20] Some authors recommend upper gastrointestinal radiography and endoscopy instead of CT suggesting on the fact that obesity produces technical difficulties and low image quality.^[21] Early postoperative leak tests with methylene blue and gastrografin are recommended by many authors although they are shown neither specific nor sensitive by retrospective reviews.^[22,23] It is crucial to recognize the fact that a normal test cannot rule out a fistula and may cause delay in diagnosis.

The treatment of leaks may include early oversewing, drainage, endoscopic clipping, stenting, fibrin glue application or surgery (use of Roux limb, total gastrectomy, braun anastomosis).^[24] Immediate surgical intervention in an unstable patient with washout drainage and, if possible, suture show better outcome.^[3] For clinically stable patient, more conservative approach with adequate hydration, proton pump inhibitors, nil per os, nutritional support, percutaneous drainage of any collection and broad spectrum antibiotics are more reasonable.^[3,14,15] If the leak does not heal with conservative measures, endoscopic management (over the scop clips, sealant materials, endoprosthesis or stents) should be considered.^[25–27] Usually re-operations are accompanied by high morbidity and mortality.

Intestinal Obstruction and Internal Hernia

A well documented complication of bariatric surgery is internal herniation leading to intestinal obstruction with an incidence rate of between 1 to 9%.^[28–30] Due to the difficulties in detecting internal herniation with standard imaging techniques and potentially catastrophic risk of a missed diagnosis, surgical exploration (laparoscopic or open) remains common in any patient with a high clinical suspicion of internal hernia.^[31] Four types of internal hernia have been reported after laparoscopic Roux-en-Y gastric bypass: Peterson’s hernia, jejuno-jejunal hernia, mesenteric and mesojejunale herniae.^[32] The most com-

mon one is Peterson's defect; the one located posterior to the Roux limb. This complication could be prevented by immediate closure of the defect perioperatively, thus avoiding lifethreatening outcomes. Steele et al. have reported that antecolic antegastric approach with the closure of internal defects lead to fewer internal hernias than retrocolic retrogastric approach.^[33]

Early intestinal obstructions after bariatric surgery may occur at entero-entero anastomosis due to angulation, edema or formation of early adhesions. The clinical symptoms are elevated gastric drainage from nasogastric tube, nausea, vomiting, abdominal distension and pain. In some patients, dehydration, tachycardia, electrolyte imbalance may complicate the clinical feature. Some conservative measures (nil per os, nasogastric drainage, electrolyte and fluid replacement, intestinal rest) may solve the problem. However, sometimes surgical intervention becomes imperative.

Bleeding

Criteria for the diagnosis of bleeding include intraoperative injury of a major vessel or viscera with blood loss greater than 500 mL, hemorrhage causing hemodynamic instability, and a decrease in hemoglobin of at least 2.0 g/dL. The origin of the bleeding may be intraluminal (hematemesis, melena or rectal blood loss) or intraperitoneal (bleeding from abdominal drains).^[29] The reported incidence of bleeding is quite variable and depends on the tool with which the assessment is made. It may be minor that only conservative treatment is quite enough. However, it may also require blood transfusions or even re-exploration to be fixed. Staple lines are the most common source of bleeding and can indicate complications in the peritoneal cavity or the gastrointestinal lumen. The presence of abdominal drains aids in the diagnosis allowing the amount of blood to be monitored and also emptied. Bleeding into lumen is usually self-limited though it may require endoscopic intervention or even surgical intervention in cases of hemodynamic instability or worsening of clinical signs. In case of bleeding, thrombosis prophylaxis should be suspended till clinical stability is ensured.

Stricture

The mostly seen one is stenosis of the gastrojejunal anastomosis. The causes of a stenosis of the gastrojejunal anastomosis are multifactorial and there is no consensus regarding the management. Endoscopic dilatation ap-

pears to be effective and safe. Surgery is reserved for failures of the endoscopic treatment.^[34]

Persistent strictures after laparoscopic sleeve gastrectomy can be extremely symptomatic and may require revision surgery. The incidence of strictures after sleeve gastrectomy is around 3.5%.^[35] It is mostly induced by scar retraction. The incisura angularis is the place with the greatest potential place for stricture development. Many authors agree that stricture formation is related with the size of the calibration tube; smaller size thus tighter sleeve and increased risk of stricture. Symmetrical lateral traction while stapling is of the utmost importance. Asymmetrical traction might lead to twisted sleeves that may cause functional stenosis. In short segment strictures, multiple endoscopic balloon dilatation may be successful. Long-segment stenoses or the ones that do not respond to endoscopic techniques may ultimately require other surgical approaches. These treatment options are seromyotomy, sleeve wedge resection, and conversion to gastric bypass.^[35]

Wound Infections

Surgical wound infections include the presence of cellulitis or signs of peri-incisional necrosis. Abdominal wall infections that require hospitalization should be treated promptly with IV antibiotics and/or surgical debridement. There are patients, especially with diabetes, reported whose infections have evolved to necrotizing fasciitis and died.^[29] Deep surgical wound infections have a similar incidence to that reported in the literature for open or conventional surgery. Given the performing of this procedures videolaparoscopically, the incidence of these severe complications is currently decreasing. Although it may be related to the patient's risk factors such as age above 65 years and diabetes, this entity should be kept in mind.

Pulmonary Embolism

Pulmonary thromboembolism, a severe complication associated with bariatric surgery, requires great attention from the medical team given the high mortality rate associated with this condition. Clinical presentation consists of respiratory failure and diagnosis confirmed by CT Angiography. The incidence of pulmonary thromboembolism following bariatric surgery ranges from 0.05% to 1% in the literature.^[36] Mortality associated with PTE has been as high as 75% in some case series, and it has been the third leading cause of mortality, after sepsis and cardiac

causes, in a prospective multicentric study conducted on over 60,000 patients. The prophylaxis for deep venous thrombosis include elastic stockings, early ambulation and prescription of an antithrombotic drug until the 21st postoperative day. However, despite prophylactic measures, PTE may occur early or late in some patients. Better stratification of the risk of deep venous thrombosis in patients eligible for bariatric surgery should be studied in large clinical series.

Anastomotic Ulcer

Gastrojejunostomy after Roux-en-Y gastric bypass (RYBG) has been shown to be susceptible to anastomotic ulcers. Underlying mechanisms are not entirely clear, but reduced local blood flow, anastomotic tension, and/or *Helicobacter Pylori* infection may play a role.^[37] Furthermore, gastrojejunal anastomosis may be exposed to the undiluted acidic juice produced by the gastric pouch. The incidence of anastomotic ulcer of the gastrojejunostomy after RYGB varies between 0.6 and 16%.^[38] Clinical features include pain, lack of appetite, abnormal weight loss, nausea, vomiting, anemia, even fistula. Prevention and management is still a matter of debate. Proton pump inhibitors are efficient; however, despite the preventive use of proton pump inhibitors, anastomotic ulcers may still occur in up to 16% of post-Roux-en-Y gastric bypass patients.^[38] Despite conservative treatments, one third of patients will need surgical revision. The rationale behind surgical revision is the correction of technical risk factors for anastomotic ulcers including large gastric pouches, vertically oriented pouches, gastrogastic fistulas, and local ischemia caused by tension.^[39]

Rhabdomyolysis

Rhabdomyolysis is a clinical and biochemical syndrome varying from asymptomatic increase of muscle enzymes, to acute renal failure, compartment syndrome, and even death. Rhabdomyolysis is produced by injury and necrosis of the skeletal muscles and the subsequent release of intracellular toxic substances into circulation. Increased compressive pressure owing to excessive weight has been recognized as a risk factor in obese patients. The incidence of rhabdomyolysis after bariatric surgery is not clear, having been estimated from 1.4% to 75%.^[40] Prolonged surgery, extreme surgical positions, ASA physical status III-IV, and the presence of diabetes or hypertension have been identified as factors associated with the development of rhabdomyolysis.^[41]

Signs and symptoms have been usually reported during the first 24 h after the injury. The suspicious diagnosis based on clinical manifestations (reddish-brown urine, gluteal and back pain, oliguria) must be confirmed by laboratory studies. A five-fold elevation of serum CK level is considered diagnostic.^[42]

The subsequent development of acute renal failure, considered as a major prognostic factor in rhabdomyolysis, occurs in 20–50% of patients with a mortality of 20%. Early diagnosis is the cornerstone of a successful outcome of this increasingly recognized complication. Once rhabdomyolysis is detected, vigorous fluid administration and forced diuresis seem to be the best measures to avoid fatal consequences.^[42]

Abdominal Wall Complications

Trocar or port site hernia is defined as an incisional hernia occurring after minimally invasive surgery on the trocar incision site.^[43] The spread of laparoscopic surgery for many abdominal procedures has increased the occurrence of trocar site hernias (1–6%), along with their related complications such as bowel or omentum incarceration, intestinal obstruction or perforation.^[44] Bariatric surgery combines two important risk factors in hernia formation including obesity and difficulty in port-site closure. Standard closure technique of all layers, from fascia to cutis, at the port-site, can be very hard. Several techniques have been proposed to close the trocar wounds minimizing the risk of hernia formation such as the use of special devices, endoscopic suture or different ways to introduce trocars, but all solutions imply a cost in terms of time or money.

Late Complications

Nutritional Deficiencies

Together with the popularity of bariatric surgery rising for both extremely obese adults and adolescents, clinicians must be aware of pre-existing nutritional deficiencies in overweight and obese patients. So as to optimize long-term health after bariatric surgery, it is important to screen for and recognize symptoms of deficiency, prescribe appropriate supplementation and treat common and rare nutritional deficiencies that may emerge both in the short term and long-term post-operatively. Studies of extremely obese adults undergoing bariatric surgery have identified a wider array of pre-existing nutritional deficiencies prior to surgery. The cause of these nutritional deficiencies

in overweight and obese individuals is not completely known, but in large part, is likely due to higher intake of higher-calorie processed foods associated with poor nutritional quality.^[45] All types of bariatric surgery lead to very reduced total calorie intake, especially in the first 6 postoperative months, typically ranging from 700 to 900 calories per day, contributing to the decreased intake of all macronutrients, especially protein, although patients are advised to consume at least 1 to 1.5 gm of protein per kg of ideal body weight (a minimum of 60 gm of protein per day). Some studies have indicated that protein intake in the first year after surgery may be much lower than recommended, often closer to 0.5 gm/kg.^[46] Certainly, any preexisting hypoalbuminemia could be worsened if adequate protein intake is not achieved during the periods of highest caloric restriction. The reported prevalence of hypoalbuminemia in the literature ranges from 3-11%.^[47] However, longer Roux limb lengths in RYGB can increase the risk of hypoalbuminemia and low protein intake can lead to increased hair loss and contribute to poor wound-healing.

Micronutrient deficiencies are the most likely long-term adverse events after bariatric surgery and can lead to wide-ranging symptoms, most commonly anemia (10% to 74%) and neurological dysfunction (5-9%).^[48] It is clear that micronutrient deficiencies are relatively common in patients before and after all types of bariatric surgery and, therefore, it is important to screen patients at baseline, and at a minimum, annually for deficiencies. In women who become pregnant after bariatric surgery, it is critical to screen and treat nutritional deficits before and during pregnancies.

Iron deficiency is perhaps the most common and earliest nutritional deficiency to occur following bariatric surgery, occurring in up to 12 to 47% of patients, particularly after RYGB and BPD.^[46] Menstruating and pregnant females are at the greatest risk. Anemia can also be exacerbated by chronic inflammation secondary to obesity. Routine multi-vitamin supplementation does not appear to be sufficient to prevent iron deficiency after RYGB, and in most cases supplemental iron is necessary.^[49] If refractory to oral iron supplementation and correction, parenteral iron therapy or even blood transfusions may be necessary, especially in menstruating and pregnant women.^[50]

Accordingly, 25 to 80% of adult pre-bariatric patients may have baseline vitamin D deficiency.^[51] In a study of 70 adult patients presenting for RYGB, mean 25-OH D levels have

also been inversely correlated with BMI, lending support to the theory that fat mass may influence bio-availability.^[52] Of concern is that 45% of these individuals continued to have insufficient vitamin D levels despite recommended post-operative supplementation. Optimal dosing of vitamin D after various types of bariatric surgery remains unclear. A recent expert guideline suggests supplementation of 2000 IU per day for patients after BPD-DS, with no additional vitamin D3 for patients after RYGB or AGB, above that associated with the elemental calcium supplement.^[53] One recent prospective randomized clinical study has indicated that doses up to 5000 IU appear to be safe and necessary in some adult patients after RYGB to maintain vitamin D sufficiency, yet not enough to prevent vitamin D insufficiency for others.^[54] Taken three times a day, calcium citrate + vitamin D supplements can provide up to 1500-1800 mg of calcium and 1200-1500 IU of vitamin D. While these amounts of calcium and vitamin D are likely to be sufficient for patients after purely restrictive procedures, patients after RYGB may require additional supplemental vitamin D3 and patients after BPD-DS should be prescribed supplemental vitamin D3.

Studies of baseline nutritional deficits in adults presenting for bariatric surgery also indicate potential vitamin A and E deficiencies in the extremely obese. Up to a 12.5% prevalence of low levels of retinols and beta-carotene has recently been described pre-operatively in adults undergoing bariatric surgery with increased severity post-operatively.^[55] In general, fat-soluble vitamin deficiencies, including vitamin A (69%), E (7.1%) and K (68%), appear to be more common after BPD due to significant fat malabsorption.^[56]

Routine annual monitoring is, therefore, currently suggested only after BPD or BPD-DS procedures, but should be considered after any bariatric surgery procedure if symptoms develop. Prevalence of pre-operative folic acid deficiency (up to 54%) has been noted in international studies prior to bariatric surgery. Low folate levels after bariatric surgery therefore can indicate lack of adherence to multivitamin supplementation.^[57] Low vitamin B12 levels have been reported prior to bariatric surgery in up to 18% of severely obese adults. Vitamin B12 deficiency post-operatively is more commonly associated with RYGB (up to one third of patients), but the rate is significantly reduced to approximately 4% of patients with vitamin B12 supplementation.^[49,58] Multivitamin supplementation alone is not sufficient to prevent vitamin B12 deficiency.

Daily oral vitamin B12 (350–600 ug per day) is effective in correcting deficiency in 81 to 95% of the patients and intramuscular monthly vitamin B12 injections are another option in patients who have trouble adhering to daily oral supplement.^[59]

Thiamin deficiency is more common after procedures involving gastric bypass due to decreased acidification of food and impaired absorption, but has also been reported in isolated cases after purely restrictive procedures.^[60] Asymptomatic thiamin deficiency has been reported in up to 18% of patients one year post RYGB. Severe thiamin deficiency leading to peripheral neuropathy, and in some cases Wernicke encephalopathy, has been reported in both adults and adolescents after bariatric surgery.^[61] Ascorbic acid or vitamin C deficiency has been noted in up to 36% of adult patients aged 20 to 66 years prior to bariatric surgery. Ascorbic acid deficiency has correlated with higher BMI, younger age, decreased intake of fruit and vegetables, and lack of vitamin supplementation. More recently, ascorbic acid deficiency has been reported in 34.5% of post-RYGB patients at one year post-operatively.^[62] Low serum zinc levels have been reported in both pre-operative (up to 28%) and post-operative bariatric patients (36–51%).^[63] Cardiomyopathy presumably secondary to selenium deficiency has been reported nine months following BPD. Copper deficiency causing anemia and neurological impairment has been reported in two patients following RYGB and copper deficiency has also been shown to increase in prevalence after BPD.^[63]

Bariatric surgery, an increasingly acceptable treatment for severe obesity in both adults and adolescents, can also lead to several predictable nutritional deficiencies and worsen pre-existing ones. It is critical to screen for nutritional deficiencies in obese patients prior to bariatric surgery and at regular intervals after bariatric surgery, and encourage adherence to supplementation.

Cholelithiasis

Obesity and rapid weight loss are known risk factors for gallstone formation, and thus, it is no surprise that approximately one third of patients may develop gallstones after bariatric surgery. Furthermore, 10–15% of patients will require cholecystectomy for complaints related to gallstones.^[64] After bariatric surgery, weight loss of more than 25% of the original weight is considered to be the only predictive factor to postoperative gallstone formation.^[65] Asymptomatic gallstones are reported in 26.5%

in gastric banding patients though only 6.8% of patients become symptomatic postoperatively.^[66] In addition, asymptomatic gallstones range from 30 to 53% after 6 to 12 months postoperatively whilst symptomatic gallstones occur by 7–16% in gastric Roux-en-Y bypass patients. Despite that, cholecystectomy after Roux-en-Y gastric bypass is necessary only for 3.9 to 17.6% of the patients.^[67] Some centers routinely perform cholecystectomies with bariatric procedures to prevent complications of cholelithiasis whereas other centers choose to administer ursodioxycholic acid as prophylaxis for 6 months postoperatively.^[68] Clinicians against prophylactic cholecystectomy suggest that the operation may increase the overall operative time and length of hospital stay and that a cholecystectomy may be easier to perform after weight loss has occurred.^[69] Moreover, laparoscopic cholecystectomy in bariatric patients may be technically challenging due to suboptimal port placement and difficult body habitus.

Complications Specific to Gastric Banding

Band erosion occurs gradually and it is most often asymptomatic. In some rare cases, it may be manifested by failure to lose weight and weight regain. Band removal with delayed or immediate conversion to another bariatric procedure is feasible with an acceptable morbidity, preventing weight regain in most cases.^[70] Band slippage is another complication specific to gastric banding. Upper gastrointestinal tract imaging is required to diagnose this complication. Treatment options for patients with slipped bands include band removal, gastric reduction and reapplication of the original band, and band replacement.^[71]

Conclusion

The role of experience of the medical institution is often evaluated as a factor that may reduce the incidence of complications, especially through provision of integrated care for morbidly obese patients, including adequate preoperative preparation, standardization of the surgical procedure, and postoperative care aimed at early detection and immediate management of complications.

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