Chapter 3

Complications of Bariatric Surgery

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Additional information is available at the end of the chapter

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1. Introduction

The widespread adoption of bariatric surgery as a major therapeutic option for patients with severe obesity, especially when associated with serious metabolic comorbidities, is a relatively recent phenomenon and has inevitably resulted in large numbers of patients who may present to physicians who have not had specific training in this field of medicine. Bariatric surgery has also become one of the targets of the medical tourist industry, where patients can choose to go abroad to get surgery which may cost only a fraction of what it would cost in the USA. In the event of a problem occurring after the patients return home, they will most likely present to an adjacent Emergency Room, often with little knowledge or documentation of what they had and why. The purpose of this chapter is to highlight the major things that can go wrong after bariatric surgery. The term *complications* is generally restricted to situations where surgery has caused an identifiable disease process, for example abdominal sepsis, bowel obstruction, or hemorrhage or malnutrition. In addition there are other adverse effects of surgery which are not true complications but which nevertheless result in a dissatisfied patient, for example, weight regain after initial success, the presence of large floppy folds of skin, or persistent GI symptoms of nausea and vomiting. Although major complications after contemporary surgery are relatively rare, they do consume a great deal of healthcare resources to investigate and treat. They not only cause symptoms and anxiety for the patient and family, but also may be a major source of stress for the bariatric team especially if hostility in the doctor-patient relationship leads to a lawsuit. It is therefore especially important that all physicians are familiar with the major forms of bariatric surgery and the spectrum of complications to which the surgery may give rise.

Early recognition of complications and prompt treatment or referral to a specialist center is the most important way to minimize their ill effects. This chapter will focus on the definition, recognition and range of treatment options for the major complications of the principal bariatric procedures in contemporary practice, based on our own experience in a tertiary

referral center as well as major reports in the recent literature. The details of individual operations are covered in other chapters in this book and will not be recapitulated here.

The simplest way to classify complications is to stratify them according to the time since surgery, generally into three major time periods

- Perioperative (the first month)
- Intermediate (the first 12 months)
- Late (one or more years after the surgery)

Although there is some overlap, the spectrum of complications in each time period is sufficiently distinct to consider them separately. Perioperative complications are always managed primarily by the surgeon but later events may be managed by the primary care physician or other specialists.

2. Perioperative complications

Responsibility for recognition of perioperative complications always rests with the operating surgeon. There is evidence to suggest that complications are more frequent after open bariatric surgery than laparoscopic procedures, but some of these differences are undoubtedly related to the fact that until recently, open procedures were used for the most high risk patients who were felt unsuitable for laparoscopy [1].

Perioperative complications can be classified simply into Cardiorespiratory problems which include myocardial infarction (MI), pulmonary embolism (PE) and/or Deep Venous Thrombosis (DVT), Surgical problems (leak or stenosis of the anastomosis, bleeding, and incisional problems) and issues related to the underlying comorbidities, such as the management of CPAP machines or diabetic, transplant or antipsychotic medications.

2.1. The moribund patient

The most alarming situation confronting the surgeon in the early postoperative phase is the patient who deteriorates within a very short time, usually with tachycardia and hypotension and hypoxia, prompting the need for intubation and administration of pressors. Although rare, it is important to reach a diagnosis quickly or the patient will rapidly go into an irreversible decline. Most such cases are accounted for by a quartet of conditions – pulmonary embolism, myocardial infarction, bleeding and sepsis (usually from a leak) – which must be immediately considered before thinking of more esoteric conditions. When this state occurs years after surgery, it is generally thought to be due to sepsis, but micronutrient deficiencies, particularly of Thiamine (Vitamin B1) have occasionally been incriminated in the pathogenesis of this critical state. This is discussed in the section of late complications.

2.2. Cardiorespiratory complications

All of these typically present with chest pain or discomfort, shortage of breath, anxiety and tachycardia. Perioperative *myocardial infarction* is high on the list in a patient with a known history of coronary artery disease especially if it has required stenting or coronary artery bypass grafting in the past [2]. Typically such a patient is on antiplatelet medication such as aspirin and clopidrogel (Plavix) which has been discontinued a week before surgery and not restarted because of the risk of creating bleeding. A patient with chest pain after surgery should have immediate 12-lead EKG and measurement of troponin levels. Elevated troponin levels or the presence of ST elevation should prompt immediate cardiology consultation as early clot dissolution or re-stenting can limit the myocardial damage. Surgeons are naturally worried about resumption of antiplatelet agents soon after surgery, but a reasonable compromise for patients who have stopped antiplatelet therapy is to resume aspirin in the recovery ward, usually by suppository, and restart other agents such as Clopidrogel a week later when the risk of bleeding should have receded.

2.2.1. Venous thromboembolism (VTE)

Many factors commonly found in the bariatric population predispose to VTE, including the mechanical effects of superobesity, prior VTE history, obesity hypoventilation syndrome, use of hormonal therapy, immobility and venous stasis disease. Most surgeons advocate both mechanical and chemical modes of prophylaxis in the perioperative period, and many also recommend continuation of heparin therapy for several weeks after discharge [3].

Pulmonary embolism (PE) is very rare after laparoscopic bariatric surgery, but is a significant risk in patients undergoing open surgery or who have surgery for complications especially in the context of a prolonged hospital stay. The overall incidence has been estimated at 0.9% but fatalities are estimated at 0.03% [4, 5].

Patients with a past history of Venous Thromboembolism are at greatest risk, especially if anticoagulation was stopped in preparation for the surgery. The key features are hypoxia and hypotension and tachypnea, and the patients are often anxious, sometimes causing the symptoms to be dismissed as "hyperventilation syndrome." The patient may be cyanosed with cool sweating extremities. An EKG and chest x ray will be done immediately, chiefly to exclude other serious pathology such as MI or tension pneumothorax. Massive pulmonary embolism may be so rapidly fatal that no confirmation of diagnosis is possible, and the majority of deaths that occur in contemporary practice from pulmonary embolism happen within an hour of the onset of the symptoms.

A patient with these features suspected of pulmonary embolism needs a rapid diagnosis. To begin anticoagulation or more invasive treatment such as fibrinolytic therapy shortly after major surgery requires more than strong clinical suspicion. A bedside echocardiogram may show right ventricular dilation, and commonly a chest CT angiogram will show significant filling defects. CT scanning is immediately available in most facilities and gives information about massive embolism comparable to pulmonary angiography. CT confirmation is sufficient to justify invasive therapy such as anticoagulation or thrombolysis. There

is no time to wait for biomarkers such as BNP and D-Dimer or the results of a nuclear medicine (V/Q) scan. The therapeutic options depend on the severity of the situation and include anticoagulation, fibrinolytic agents, catheter directed thrombolysis and pulmonary embolectomy. Insertion of a caval filter pending the introduction of anticoagulation is often recommended in patients with new-onset deep venous thrombosis. However, prophylactic insertion of caval filters in patients with significant risk factors is more controversial and is generally not recommended [6].

Deep venous thrombosis may occur in up to 1.3% of patients after open or laparoscopic bariatric surgery. Despite the enhanced mobility after laparoscopic surgery, the incidence of DVT may not be reduced as much as expected because the benefit of early motility may be offset by the tendency of pneumoperitoneum to promote DVT. All major bariatric surgeons are agreed that a combination of mechanical (sequential calf compression devices or anti-embolism compressive stockings) and chemical (either unfractionated or low-molecular-weight heparin) should be employed prophylactically. Some surgeons advocate continuation of heparin after discharge for up to 30 days [7]. Detection on purely clinical grounds is often difficult because of the physical dimensions of the patient's legs, but asymmetrical edema or leg pain should encourage the surgeon to search for DVT, usually by duplex scanning.

2.3. Bleeding

Postoperative bleeding rarely presents with such a catastrophic deterioration, but is associated with tachycardia, oliguria and falling hemoglobin (Hb) level. Obvious risk factors include the need for preoperative anticoagulation, or surgery rendered difficult by adhesions or limited visibility [8].

In a patient who is hemodynamically stable there is time for confirmatory checks to ensure a downward trend in Hb, because sometimes a patient with tachycardia or hypotension for other reasons will be administered large volumes of IV fluid causing the Hb to drop transiently by hemodilution. Postoperative bleeding may occur into the peritoneal cavity or into the GI tract [9-11].

In the former, the only evidence of bleeding is indirect, and is inferred when the patient shows general signs of hemorrhage including tachycardia, oliguria, hypotension and falling Hb levels. If the recent surgery was known to be difficult the source may be easy to suspect: typical sites are the dissection round the cardia, the omentum, or inadvertent injury to the liver or spleen. Unless the patient is becoming hemodynamically unstable, most surgeons would recommend transfusion of up to two units of packed red cells, since most of these bleeding sites are self limiting. A patient who continues to bleed as evidenced by persistent tachycardia and failure of the Hb to come up and stay up appropriately after transfusion is most safely managed by return to the operating room. Repeat laparoscopy generally shows a substantial amount of clot in the peritoneal cavity, but in the majority of cases the bleeding has stopped.

GI Bleeding is associated with the general signs of hemorrhage but there is also vomiting of blood or passage of blood per rectum. The source of GI bleeding is almost always from the staple or suture lines. Other sources of GI bleeding seen in non-bariatric practice such as

esophageal varices or peptic ulceration are largely irrelevant to the bariatric surgery patient. The three potential sources are from the Gastrojejunal (GJ) anastomosis, from the Jejuno-jejunostomy (JJ), or from the long staple line in the bypassed stomach (Figure 1). GI bleeding is more serious than intraperitoneal bleeding because the low pH of the stomach inhibits the coagulation process and the bleed is less likely to be self limiting. Therefore, a hemodynamically unstable patient with a GI bleed should be rapidly resuscitated and returned to the operating room immediately. It is important to have an experienced upper GI endoscopist available. If, on putting in the laparoscope, the remnant stomach is seen to be very distended, the source is likely in the suture line of the bypassed stomach. The stomach should be opened and the clot evacuated. A continuous running suture to under-run the staple line is all that is required to stop the hemorrhage and it is not necessary to open the staple line itself.

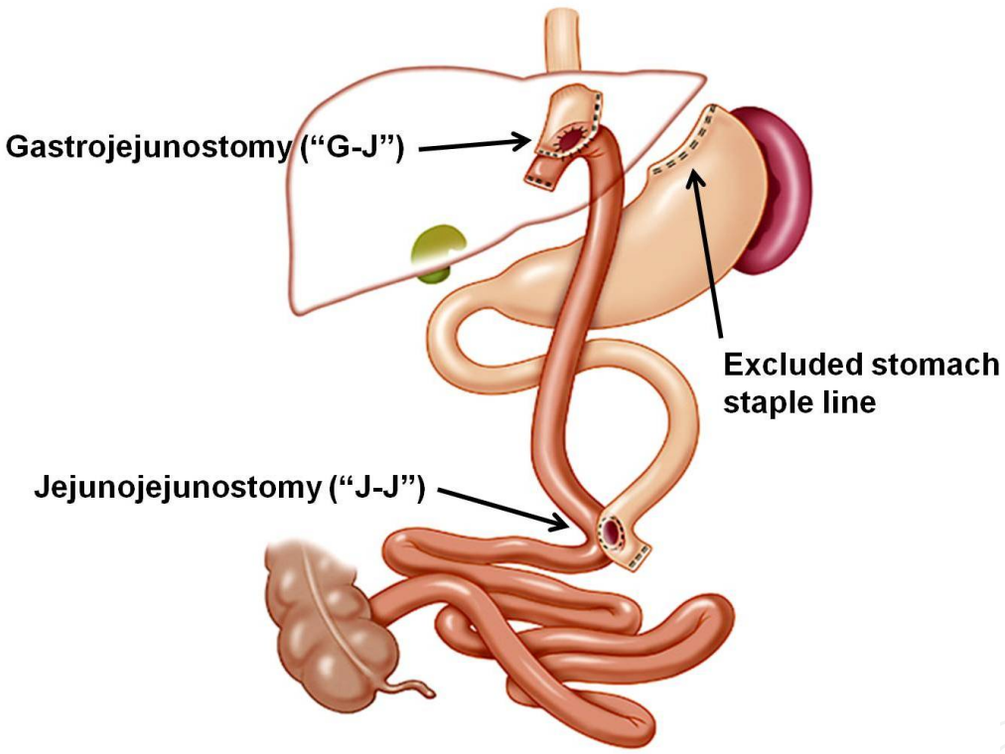

Figure 1. Diagram illustrating the potential sites of GI bleeding after gastric bypass.

Bleeding from the GJ or JJ anastomosis is more problematic and may require intraoperative upper GI endoscopy to identify the site. The bariatric surgeon who is also a skilled endoscopist has the advantage of knowing the anatomy of the reconstruction, but in typical practice, a gastroenterologist or other GI surgical colleague will be helpful during return to the operating room. Extreme gentleness of manipulation and limitation of air insufflation is essential. If the operating surgeon sees that the remnant stomach is not distended, the Roux limb should be clamped with long grasping forceps while the endoscopist inspects the gastric pouch and GJ anastomosis. This limits the diffuse dilation of the entire GI tract by the endoscopist. If bleeding is identified, it may be clipped if it is from a single site and accessible to the endoscopist, or

the surgeon can reinforce it with a full thickness layer of running monofilament absorbable suture. If there is no blood in the gastric pouch and the anastomosis is not bleeding, the bowel should be clamped just distal to the JJ anastomosis and the scope advanced distally. Bleeding of sufficient magnitude to justify return to the OR often causes large amounts of clot into the jejunum which can then become obstructed [12].

In this case, the surgeon can make a small enterotomy and evacuate the clot because manipulating the anastomosis in this situation may cause the whole reconstruction to fall apart. If there are no big clots visible, the operating surgeon can assist the passage of the scope by pushing the jejunum up over the scope rather like putting the foot into a long sock. In this way the JJ anastomosis may be reached with a conventional endoscope.

In addition to physical control of bleeding, either endoscopically or surgically, an intravenous infusion of pantoprazole (4-8mg /hour) is recommended to produce sustained reduction of gastric acidity and facilitate the clotting process within the upper GI tract.

2.4. Leakage and sepsis

This is the commonest and most feared early complication, and the one most directly related to surgical technique. Leakage can occur from any suture or staple line after gastric bypass or sleeve gastrectomy or even from unrecognized perforation at the time of adjustable band insertion. In practice the two most common sites to leak are the staple line after sleeve gastrectomy (where the incidence is 1-3%) and the GJ anastomosis after gastric bypass where the incidence is in the 1% range. In revisional bariatric surgery, the risks are much higher and the incidence may be ten times higher than in first time cases.

There are two major forms of presentation: early and delayed. Very early leaks (while the patient is still in hospital) present with severe abdominal pain and signs of peritonitis because there has been no time for localization. They are generally anxious or agitated. Early leaks are presumed to be due to a technical problem in anastomotic construction such as misfiring of a stapler or inadequate suture technique. In contrast, leaks presenting in the second week, after the patient has left hospital and is taking a liquid diet, present more like intra-abdominal abscess with fever and often shoulder tip pain. These later leaks may be due to ischemia of the suture line. The development of the perforation is sufficiently gradual for some localization by omentum and adjacent structures to have occurred.

Sometimes the symptoms of chest and shoulder discomfort and shortage of breath predominate, leading to a workup to rule out pulmonary embolism. The surgeon should be aware that statistically such a patient is much more likely to have a leak than a PE and should be investigated accordingly. We often quote an old aphorism which states "*the lung is the mirror of the abdomen*" meaning that pulmonary symptoms are merely reflecting some pathologic process in the upper abdomen. There is a strong temptation for the surgeon to be in denial when faced with a patient with pain and tachycardia after surgery. Psychologically it easier to attribute the clinical picture to some less critical factor such as bowel distention, pneumonia, or narcotic dependency, but the surgeon should make strenuous efforts to detect a leak before considering these other putative causes.

Large leaks may be detected by a contrast swallow but the sensitivity is low and the study may not be available out of hours. It is easier to obtain an abdominal CT scan with oral and IV contrast, which will most likely show signs of bubbles of free air and extravasated contrast (Figure 2).

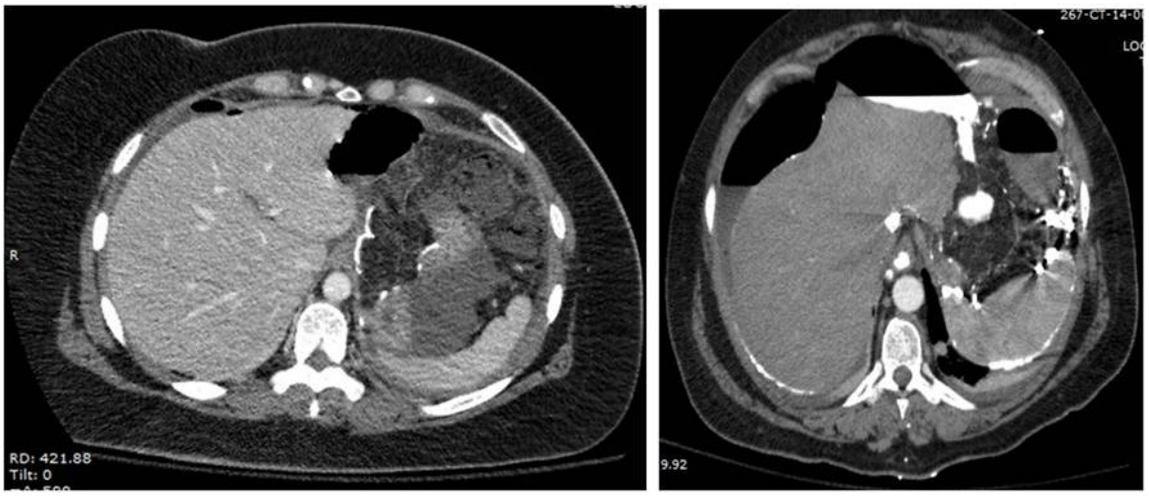

Figure 2. (a) CT Scan showing early leakage after gastric bypass. Note the small pocket of air and the small amount of fluid over the liver, (b) A more extreme example with a greater degree of free air and fluid after a gastric bypass revision. Note that the patient has residual barium many years after a prior leakage after a laparoscopic adjustable gastric band

Not every leak requires an automatic return to the operating room [13]. The range of therapeutic options for leaks includes simple drainage under CT guidance, stenting, clipping or return to the OR for resuture or revision of the anastomosis, and placement of accurate drains. It may be very difficult to identify the precise site of the leak at surgery because of the surrounding tissue distortion and adhesions. When the leak is located, resuture alone is rarely successful. Placement of accurate drainage is helpful, because if subsequently it is possible to seal the leak endoscopically by clipping or deployment of a stent, there will not be a contained pocket of contaminated contents. One promising approach is actually to insert a drain into the leak endoscopically and provide internal drainage. Typically a biliary stent is employed for this purpose. As the leak heals and the extraluminal cavity shrinks, the stent gets pushed more and more into the lumen.

Leaks from sleeve gastrectomy, regardless of whether or not it was combined with a duodenal switch, are harder to manage. Their characteristics are becoming well recognized as sleeve gastrectomy increases in popularity almost exponentially. These leaks almost always occur at the most proximal portion of the staple line. This is partly because it is a watershed area with relatively poor blood supply, and also because there is frequently a relative obstruction in the mid body portion of the stomach as the narrow gastric sleeve traverses the incisura angularis. High pressure in the proximal portion of the gastric body promotes leakage of the staple line and retards healing because the leak offers the path of least resistance for ingested liquids. Gastric juice and bile as well as swallowed saliva are present, thus patients leaking from SG

tend to be sicker than patients leaking from gastric bypass. The same principles of treatment are necessary, but in addition the surgeon must ensure that there is no distal resistance in the narrow stomach. Insertion of a stent may straighten out this tight angulation, and it may in fact be the way in which stents promote healing, since they do not produce a water tight seal. When conservative treatments fail, operative approaches include either transecting the stomach above the leak, which usually entails an esophago-jejunostomy, or bringing up a Roux limb to cover the leak as described by Baltasar et al [14].

In large series reported from specialist centers, leaks after laparoscopic gastric bypass have an incidence of 1% or less, and after sleeve gastrectomy the reported risks are in the range of 1-3%. It is likely that in routine clinical practice these rates are higher than what is reported because of publication bias, since units with higher complication rates are less likely to publish the results.

In future, advances in endoscopic technology may permit better endoscopic clipping and suturing, but these methods at present are rarely successful, mostly because the underlying conditions-tissue ischemia and high intraluminal pressure – have not been dealt with.

2.4.1. Newer operations

Gastric plication has gained some popularity in a few centers because it is potentially reversible and avoids the need for actual resection. Patients presenting with problems after these kinds of procedures are usually well informed and it is generally easy to find literature reports to elucidate confusing clinical pictures [15-17].

2.5. Wound complications

Wound problems after laparoscopic surgery are very rare, unless a circular stapler was used to create the GJ anastomosis, in which case it is difficult to protect the wound edge from the contaminated stapler as it is extracted from the body. After open surgery, in contrast, wound infections are quite common, because the great depth of subcutaneous fat permits the exudation of serum or blood which leads to infection when the surgical wound is categorized as contaminated. Quite often it only appears after the patient is discharged and it is important to be vigilant in the early postoperative course for signs of wound infection, which include erythema, induration, "peau d'orange" changes in the skin, and actual fluctuation. Although wound infection is traditionally treated by simple incision and drainage, and subsequently by frequent packing or continuous low pressure suction, it is a very long drawn out process that may require weeks or months to heal by secondary intention and increases the chance of subsequent incisional herniation.

2.6. Other rare complications

2.6.1. Mesenteric venous thrombosis

This serious complication has been described after both gastric bypass and sleeve gastrectomy, and it presents with non-specific findings of abdominal pain, nausea, vomiting and low grade

fever and are initially suspected to have a leak. The finding of thrombosis of the mesenteric and portal veins is readily apparent on CT scanning. Milder cases respond to systemic anticoagulation, but some require intraportal administration of thrombolytics, and occasionally bowel resection or splenectomy is required. It is thought to represent a manifestation of the hypercoagulable state, and a significant percentage have a history of venous thromboembolism in the past or current oral contraceptive use [18].

2.6.2. Rhabdomyolysis

One rare but immediately recognizable early complication is rhabdomyolysis of the gluteal muscles, which presents with severe pain in the buttocks or legs. It appears to be the result of pressure necrosis of the muscles, initially by unrelieved pressure on the operating table, and amplified by edema and swelling within the gluteal muscle compartment [19]. If unrecognized, extensive skin necrosis overlying the gluteal muscles may develop (Figure 3).

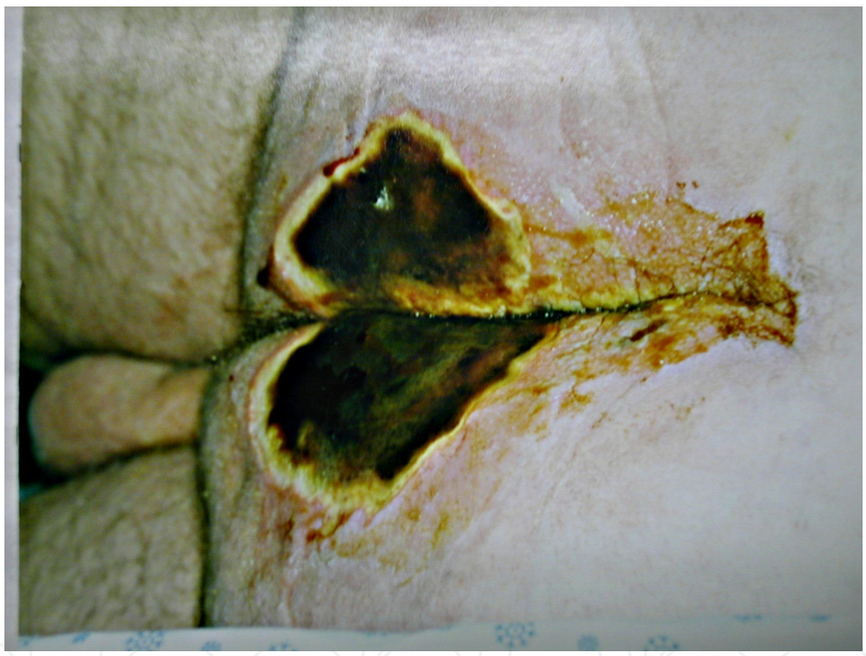

Figure 3. Extensive skin necrosis of the buttocks as a consequence of gluteal muscle rhabdomyolysis

It is most often noted in superobese males with diabetes and central obesity who have a prolonged operative procedure. The swollen muscle can compress the sciatic nerve or its roots and can release myoglobin and cause renal failure. The diagnosis is clinched by very elevated creatine kinase (CK) levels. After uncomplicated surgery, CK levels may be up to 1200 units/l in the first 48 hours, but rhabdomyolysis causes values of 30, 000 units/l or even more. It is important not to dismiss the symptoms as due to "arthritis" or its cutaneous manifestation as a decubitus ulcer, because immediate decompression may limit the loss of muscle and the extent of nerve injury. Since it was first described, widespread attention to careful padding on the operating table and limiting the duration of surgery in high risk patients have helped prevent the condition.

2.6.3. Nerve injuries

In a similar way, compression of peripheral nerves such as the ulnar or common peroneal nerve may occur because of positioning on the operating table during a lengthy operation. Traction injury to the brachial plexus may occur if the angle of the outstretched arms on the operating table is greater than 90°. When the table is put into reverse Trendelenburg position, the body tends to slide down the table and increase this angle, leading to a traction injury causing dysesthesia and motor weakness in the arms and hands. When a patient reports such findings after surgery, it is important to document the time of onset and to obtain neurological consultation, because persistence of the symptoms may prompt the patient to file a lawsuit, especially if there was a perception that the complaint was not taken seriously [20-22].

3. Intermediate term complications: the first year

After recovery from surgery, the initial rapid rate of weight loss (often 0.5kg per day at first) levels off so that the body weight has reached a plateau by the end of the first year. Several issues may arise during this time, some of them surgical problems and others related to comorbidities of difficulties in adjusting to the new state of the GI tract.

3.1. Small Bowel Obstruction

Small bowel obstruction can follow any abdominal operation. In practice, it is extremely rare after a purely gastric operation such as SG or LAGB. The potential causes are more numerous after operations involving intestinal rearrangement. In the first few weeks, trapping of a loop of bowel may occur in a laparoscopic port site, or an umbilical or incisional hernia that was not repaired at the time of the bypass. This is why it is recommended not to dissect omentum out of abdominal wall hernias at the time of bariatric surgery unless the hernia is to be formally repaired as part of the case. *Internal hernias* may occur in three situations after bypass (Figure 4). The commonest is underneath the free edge of the mesentery of the biliopancreatic limb. There is a free cut edge of mesentery in the Roux limb in addition, but herniation under this limb is rare if it is antecolic. If it is retrocolic, the opening in the transverse mesocolon or the space between the mesentery and the mesocolon (Petersen's space) are also potential sites for herniation. Most surgeons close these defects at the time of surgery but as weight is lost and the mesentery becomes thinner, it is possible for the defect to open months or years later. They are commoner after laparoscopic gastric bypass than in open operations, presumably because there are fewer adhesions after laparoscopic surgery [23].

The investigation of choice is the CT scan, because it will make the diagnosis, identify any abdominal wall defects trapping the bowel, and has the highest specificity and sensitivity for detecting an internal hernia, the so-called "mesenteric swirl" sign [24].

It is often possible to correct these situations laparoscopically because the adhesions are much less numerous that after open surgery. In addition to hernia as a cause of small bowel obstruction, adhesions especially to the J-J anastomosis may cause mechanical obstruction.

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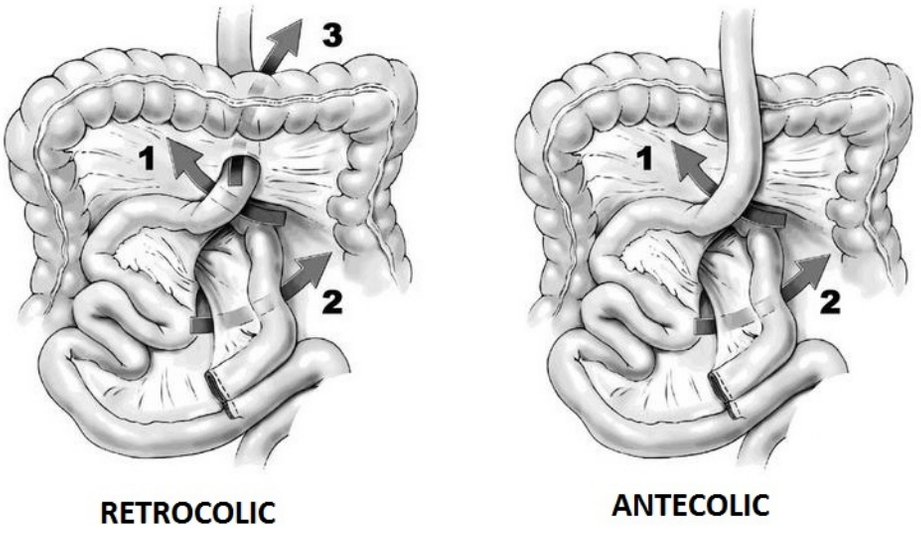

In the retrocolic approach, a loop of bowel can get trapped between the Roux limb mesentery and the transverse mesocolon (1, sometimes called Peterson's space), in the opening of the transverse mesocolon (2) or in the mesenteric opening of the biliopancreatic limb (3). In the more common antecolic approach, there is no opening in the transverse mesocolon and hernia behind the Roux limb is less common.

Figure 4. Three potential sites for internal herniation after Roux Y gastric bypass.

A unique form of small bowel obstruction may affect patients with the DS, when the biliopancreatic limb becomes obstructed (Figure 5). This presents with very severe central abdominal pain though normal bowel movements may be preserved: it may progress rapidly to intestinal ischemia and gangrene if not decompressed because it is a closed-loop obstruction. Since it is not accessible to nasogastric suction or endoscopic decompression, it requires urgent surgery. Consequently a patient presenting with severe abdominal pain after DS should have an immediate CT scan of the abdomen to check for dilated loops of the biliopancreatic limb.

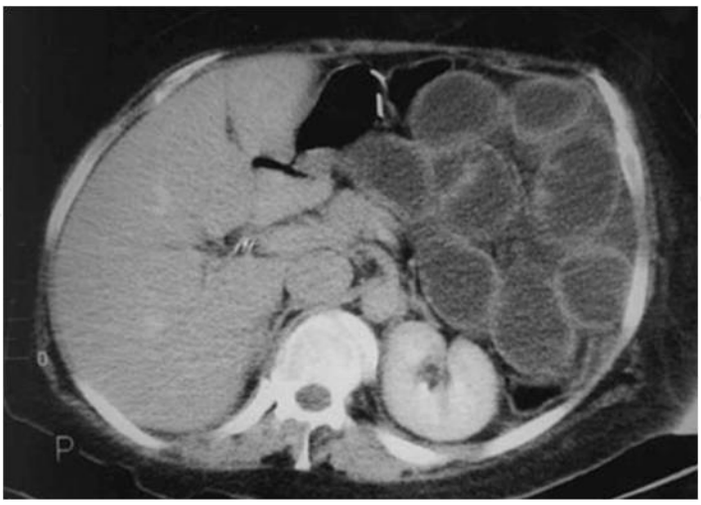

Figure 5. CT scan showing obstruction to the biliopancreatic limb after duodenal switch. Note the dilated non-opacified loops of bowel in the left upper quadrant.

3.1.1. GI dysfunction

3.1.1.1. Stricture and ulcer

The narrow gastric pouch after GBP or SG is very restrictive at the beginning, and patients can usually tolerate only clear liquids in small quantities at first. Patients are usually given written instructions to guide the gradual increase in the quantity and range of foods they can tolerate. Patients who do not receive or who do not understand such instruction have a high incidence of vomiting postoperatively. Many patients will experience a few episodes of vomiting if they relax the vigilance with which they increase their dietary intake, and some vomiting is probably inevitable as they learn how to cope with a sensation of fullness, which is a novel experience for most bariatric patients. However, in well instructed and supported patients, it should be rare. Rather than berate the patient for failure of compliance, or attribute vomiting to persistence of a psychological compulsion to eat large quantities quickly, the physician should consider organic causes, namely a stricture [25].

Some degree of stricturing of the GJ anastomosis is common, and usually resolves with time (less than 3 months) and can be managed by going back to softer or liquid foods. A more severe stricture may be due to an ulcer at the anastomosis, and the physician should inquire about consumption of NSAID or large pills, or resumption of smoking. Endoscopy typically reveals an ulcer with visible suture material or staples (Figure 6). A fibrous stricture may develop later Such strictures generally respond to one or two dilations (Figure 7). Patients are often put on proton pump inhibitors (PPI) empirically to help reduce recurrence.

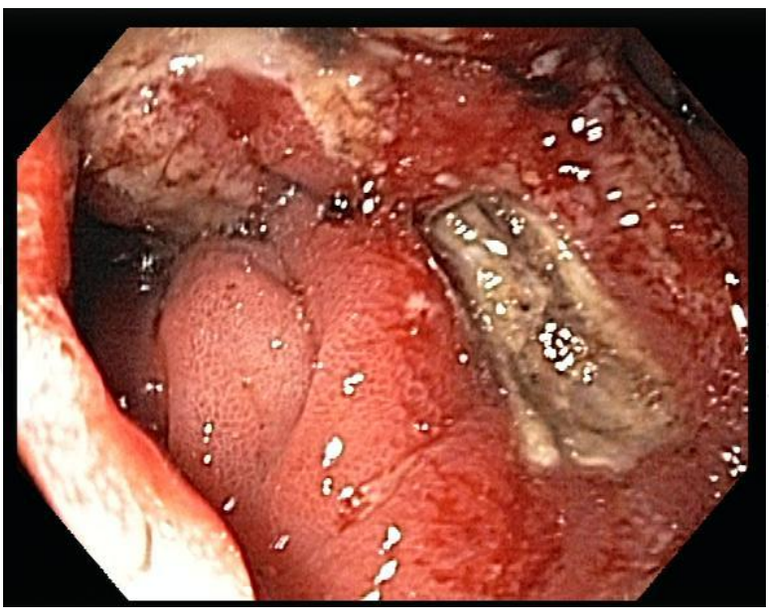

Figure 6. Ulcer at the G-J anastomosis visible on endoscopy

Severe or refractory strictures usually are caused by ulcers which do not heal, and are more frequent in smokers. Other contributing factors are consumption of over the counter medica-

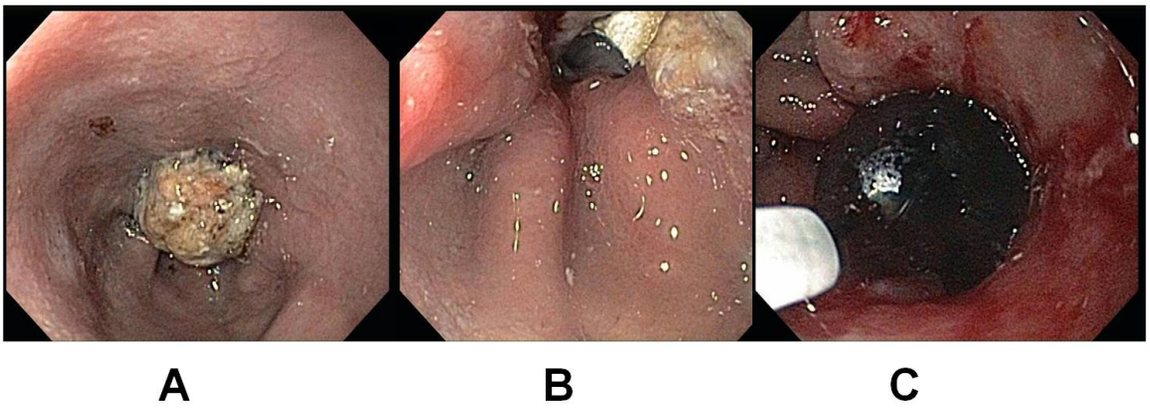

Figure 7. Stricture at the G-J anastomosis (a) obscured by food particles, (b) after removal of food material and (c) during dilation

tions for headaches or other painful conditions. This persistent ulceration may also have an ischemic component, in which case it appears to respond well to reoperation when the gastric pouch is shortened and the weight loss permits the Roux limb to be easily brought up to the stomach without tension.

3.1.1.2. Gastroesophageal reflux disease (GERD)

In general, patients with pre-existing GERD experience a profound improvement in reflux symptoms after GBP. This is largely because only a tiny fraction of the acid secreting mucosa has any access to the esophagus. Persistence or recurrence of reflux symptoms suggests that the pouch is too large, or that a hiatal hernia was undetected or uncorrected. If reflux symptoms occur for the first time after an interval of months or years postoperatively, it suggests the presence of a gastro-gastric fistula (see below).

The situation is quite different after operations such as the Sleeve Gastrectomy and duodenal switch. In both operations there is a notable incidence of persistent or new-onset GERD [26, 27]. It may be caused by overzealous resection of the proximal fundus including the gastric sling fibers, thus weakening the lower esophageal sphincter. Failure to identify and repair a hiatal hernia has also been incriminated. Finally, the configuration of the sleeve tends to produce a sharp angle at the incisura angularis which acts as a relative obstruction, thus promoting reflux. GERD after DS or SG is problematic because sometimes PPI medications are of limited efficacy or limited by side effects such as diarrhea. The most efficacious way of controlling this is to convert the situation to a Roux Y gastric bypass by transecting the stomach high up, leaving a pouch the size of a typical GBP. This effectively abolishes GERD and disconnects the esophagus from all but the smallest quantities of acid.

3.1.1.3. Constipation and diarrhea

Operations confined to the stomach, namely SG and LAGB, rarely affect bowel function. Gastric bypass typically causes constipation, which can be managed by regular stool softeners and over the counter remedies. Severe constipation is common in patients who take continuous

narcotic pain medications, but otherwise it may be a manifestation of Small Bowel Bacterial Overgrowth (SIBO). This is diagnosed by a breath test in response to ingested glucose and often responds to a course of Rifaximin, a non-absorbable antibiotic. Diarrhea after gastric bypass is rare and the stool should be checked for *Clostridium Difficile* before resorting to symptomatic treatment. Most such cases are managed by dietary adjustments such as avoidance of lactose containing products. Anecdotal evidence supports the use of probiotics in this situation. Intractable diarrhea is a terribly crippling social problem and patients will usually be referred to a gastroenterologist. In a person with no prior history of diarrhea and no evidence of infective colitis, the cause is rarely clear, and has been attributed to such entities as vagal nerve damage or bacterial overgrowth. Colonoscopy is useful to look for other forms of colitis, and long term somatostatin analogues may be helpful. We have had several patients with refractory and crippling diarrhea in which the only measure that proved of value was reversal of the gastric bypass.

The bowel habit after DS and other malabsorptive operations is typically characterized by 2-3 soft and malodorous stools daily, depending on the intake of fat or refined carbohydrates. More than this suggests either lack of dietary compliance, or bacterial overgrowth, or both. When these symptoms occur in an otherwise asymptomatic patient, we have found empirically that low-dose Metronidazole (250mg bid) produces significantly improvement. The physician should be alert to the possibility that it may be a manifestation of serious malnutrition, as discussed below.

3.1.1.4. Hyperinsulinemic hypoglycemia

Hypoglycemia associated with excessive insulin secretion, has been reported after GBP, and has been attributed to nesidiobastosis [28, 29], possibly mediated by the effect of GLP-1 on the pancreas.

It presents with episodes of altered mental status associated with profound hypoglycemia, and seems to occur in those who were non-diabetic at the time of surgery. T here is recent evidence that the phenomenon is much more prevalent than suggested by the literature, consisting as it does of small case series. A recent presentation to the American Diabetic Association described prospective continuous blood sugar monitoring after both GBP and DS and found hypoglycemic episodes, most of them asymptomatic, averaging 42 minutes per day after GBP and 85 minutes per day after DS, whereas none of the controls experienced hypoglycemia.

Any patient reporting symptoms suggestive of episodic hypoglycemia should be provided with a home glucose monitor and instructed in it use over a period of several days, to document if hypoglycemia is actually occurring. This simple step often eliminates it as a diagnosis. Typically, fasting blood glucose is normal, but drops occur after food. It thus resembles an extreme form of reactive hypoglycemia. The workup for hypoglycemia is complex, and since the episodes can cause serious mental status changes, they may have very serious consequences, for example if the patient is driving a vehicle or operating machinery. Hence prompt referral to an endocrinologist is recommended. Dietary adjustment to increase protein and reduce carbohydrate consumption may help, as may administration of diazoxide or even streptozotocin.

Some of these patients have been found to respond to distal pancreatectomy, but we have had several patients who were much improved by the much simpler technique of shortening of the Roux limb by anastomosing it to the biliopancreatic limb more proximally.

3.2. Surgical complications specific to individual bariatric operations

3.2.1. Laparoscopic adjustable gastric banding – slippage and erosion

The band in this procedure typically sits immediately below the gastroesophageal junction. It can gradually slip downwards and allow a large portion of fundus or the body of the stomach to prolapse through it, which can result in compartmentalization of the stomach with outlet obstruction [30]. Such patients have severe vomiting, dysphagia and gastroesophageal reflux. This is a serious situation where there is a risk of gastric necrosis or perforation. The band is immediately deflated in the emergency room and the patient should be taken to the operating room without delay. Most surgeons would simply remove the band and allow the stomach to recover. In delayed cases there may be necrosis of a large portion of the stomach, in which case it is safest to excise the ischemic portion, insert a feeding tube in the distal remnant stomach, and a drainage tube the remaining viable fundus and then do a planned reconstruction a few months later when the patient is in stable condition and there are no nutritional or infective problems. The reconstructive options are to do a simple gastro-gastrostomy or to convert to a Roux-Y gastric bypass.

Band erosion typically presents more slowly. Here the band erodes gradually into the lumen of the stomach. This presents with loss of any sense of restriction, weight gain, and tracking of infection from the stomach presenting as infection of the site of the subcutaneous port [31]. It is readily diagnosed on endoscopy, when the stained plastic of the band will be readily seen near the cardia. It is less common in recent years with the adoption of the *pars flaccida* technique rather than the perigastric technique. Bands which are almost completely eroded into the stomach may be removed endoscopically by cutting the band, pulling it into the lumen of the stomach, transecting the tubing, and withdrawing it through the mouth. This avoids the need to dissect the dense adhesions and scar that have sealed off the band from the peritoneal cavity [32].

3.2.2. Malabsorptive operations (Biliopancreatic Diversion and Duodenal Switch)

The principal surgical complications especially found after malabsorptive operations include

1. Biliopancreatic limb obstruction, discussed above
2. Protein-energy and other forms of malnutrition, discussed in the following section.
3. Severe and refractory gastroesophageal reflux. This has emerged as a leading cause of morbidity after any kind of sleeve gastrectomy, whether as a stand-alone operation or as part of a duodenal switch.

4. Long term complications

4.1. Malnutrition

Various forms of nutritional deficiency can develop after bariatric surgery, and the operations which produce the greatest weight loss tend to produce more nutritional problems. Modern bariatric operations are much safer in this regard than the original Jejunoileal bypass operations, but the risk remains. Deficiencies are least prominent after LAGB and SG, and greatest after BPD and DS [33, 34]. Long term follow up with regular monitoring of weight and nutritional status are designed to identify potential problems which can be addressed before a serious clinical problem develops.

Laboratory assessment of nutritional status has become more standardized in recent years and guidelines from numerous professional societies have been published. Most programs agree on the need for annual monitoring of nutritional parameters, ideally through the operating surgeon's office or the patient's primary care doctor. These annual visits include documentation of the patient's intake of food, vitamins and nutritional supplements, and measurement of a range of laboratory values as indicated in the table. Those who are lost to follow-up or whose psychosocial equilibrium is disrupted are at greater risk of nutritional deficiency. The first step in caring for any patient who presents for follow up to a different physician, or after a long interval of neglect, is to review the nature of the procedure, make a careful assessment of the current eating practices, usually with the help of a dietitian, and obtain the above laboratory values. Physicians should recognize that malnourished patients are often reluctant to seek help because of fear of weight regain, and often only come to attention when some other medical crisis occurs. It is therefore important to detect when a nutritional deficiency is something that requires surgical revision of the procedure and when it is simply a matter of education and compliance in taking additional supplements [35].

Protein Energy malnutrition is a consequence of either inadequate intake or inadequate absorption. Poor intake is usually associated with restrictive operations which cause anorexia, physical restriction of oral intake, or both. A history of extremely limited intake, frequent dysphagia and regurgitation of food particles or saliva, is common. Patients will frequently describe "bringing up foam" because the esophagus fills with saliva which then is displaced proximally when food or liquid is ingested. Maladaptive eating patterns may involve so-called "slider" foods such as ice cream and soups, often high in calories and fat but low in protein, or may be described as bizarre or crazy, as in the obsession for crushed ice.

In contrast, patients with malabsorption may appear to eat well but will often report diarrhea or steatorrhea. In both cases, there may be generalized weakness and fatiguability, and edema, which in severe cases is not limited to the ankles and feet but may be obvious even in the back and chest wall. Serum albumin is often very low, less than 3.0 g/l and in severest cases less than 2.0 g/l. These extreme cases are more frequently observed after malabsorptive operations but can occur after any bariatric operation.

Intensive dietary supervision and monitoring by the dietitian, and careful follow up to assess the effect of these interventions are essential. If the underlying reason can be corrected,

restoration is frequently achieved. Such factors as lack of awareness, divorce, unemployment, financial crisis, psychiatric illness, or development of other addictions may all contribute. A dietitian, psychologist, social worker, psychiatrist and counselor may all be necessary to help get the patient back on track. Sometimes the nutritional problems persist despite removal of any barriers to compliance. In this situation, consideration must be given to some kind of revision or even reversal of the procedure.

4.2. Revision of bariatric procedures for malnutrition

In this section, we distinguish the need for revision to correct malnutrition from some other clinical situations in which revision may be important. These other situations include failure of weight loss, or late regain of weight after initial success. At other times intractable GI dysfunction such as severe GERD or diarrhea may require surgical revision. Revisional surgery specifically for malnutrition is relatively rare, especially for purely restrictive procedures. For example, after LAGB, malnutrition is managed by deflation of the band, and after sleeve gastrectomy nutrition may be improved by dilation of the gastric sleeve or temporary stent insertion (Figure 8). One exception is the subset of patients who had some kind of banded gastroplasty in the past, in which case the band can be removed and the pouch of stomach used as the basis for a conventional gastric bypass. When malnutrition complicates banded GBP, as is the form of operation recommended by Fobi et al, the band is simply removed. In most cases this can be accomplished laparoscopically.

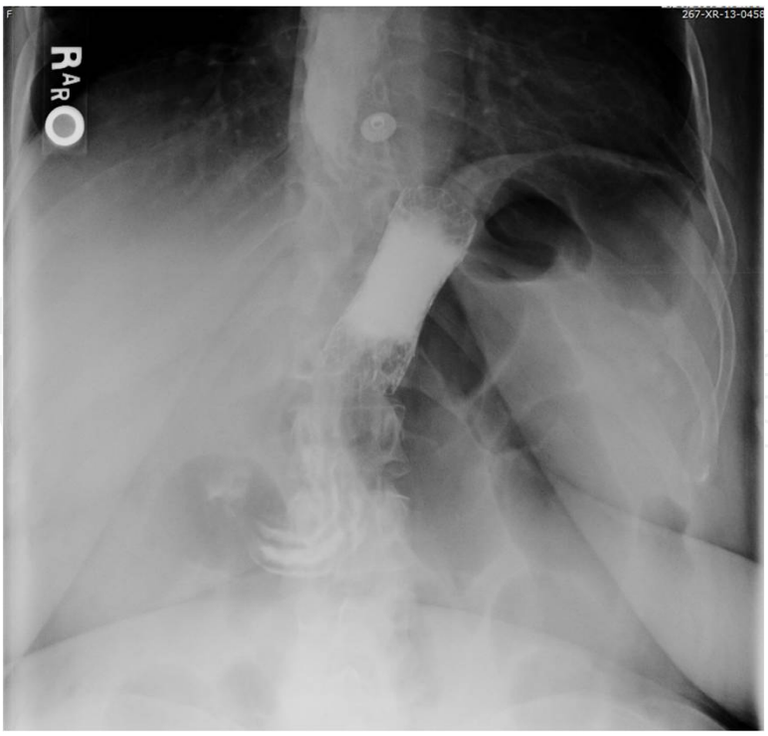

Figure 8. Correction of severe dysphagia after sleeve gastrectomy by insertion of a stent into the stomach. It is removed a few weeks later

The malabsorptive component of bariatric procedures can be reversed surgically to some extent, either by totally reversing the reconstruction or connecting the two intestinal limbs more proximally. The situation after DS is managed optimally by identifying the J-J anastomosis, and tracing the biliopancreatic and roux limbs separately, and performing a side-to-side anastomosis of the two limbs 100-200cm more proximally. This allows bile to enter the Roux limb and food to enter the biliopancreatic limb, effectively lengthening the common channel. (Figure 9) This operation, sometimes called the "Kissing X" anastomosis, effectively corrects the problems with diarrhea and hypoalbuminemia and edema [36].

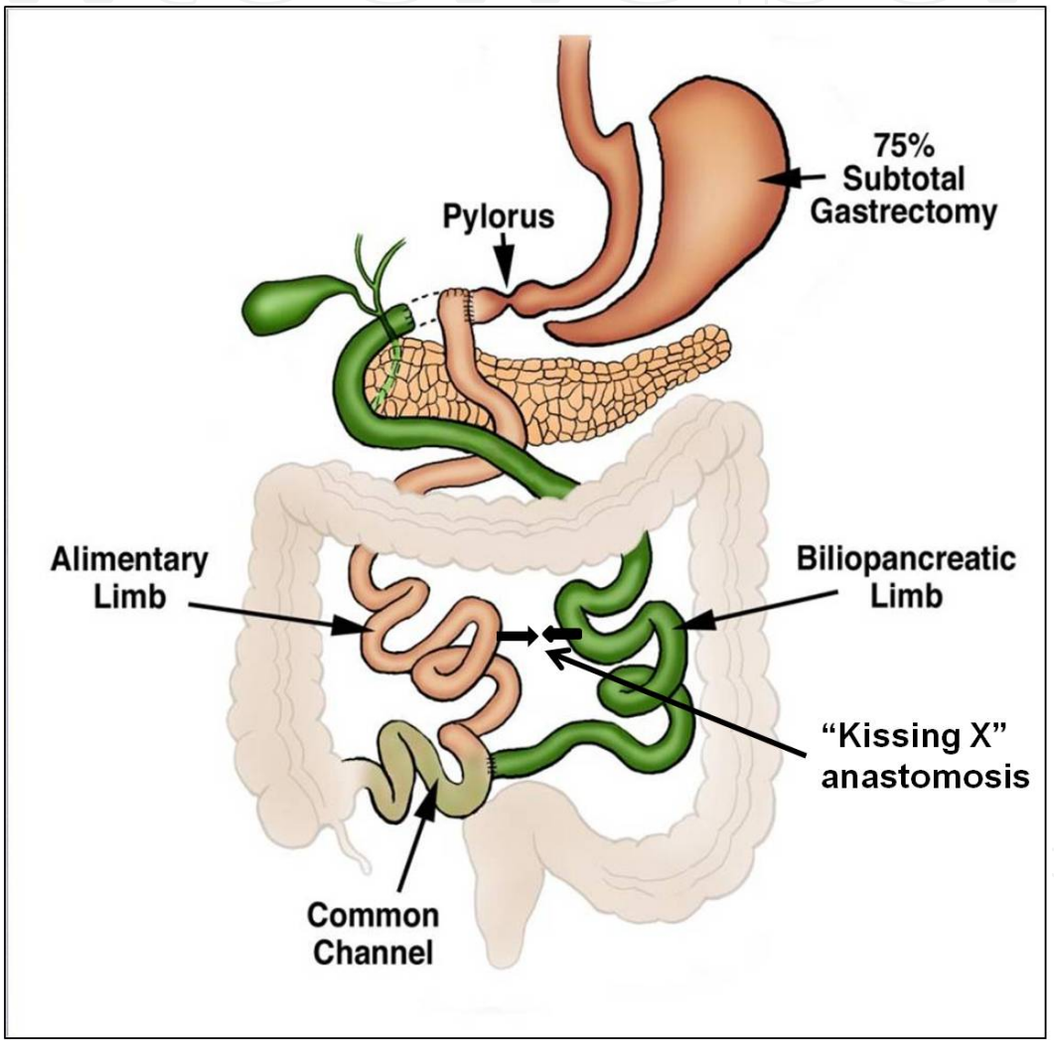

Figure 9. Correction of malabsorption by side-to-side anastomosis of the Roux limb to the Biliopancreatic limb after duodenal switch ("kissing-X" anastomosis).

In the malnourished patient after Roux Y GBP, it is simplest to insert a laparoscopic gastrostomy tube into the remnant stomach, so that all administered nutrients can be absorbed. Thereafter, the patient will be in a safer state to undergo elective reversal. Bypass reversal is accomplished by dividing the GJ anastomosis, isolating the gastric pouch, and then performing

Routine annual measurements	Purpose and clinical ituation
CBC	Basic check for anemia
CMP	Protein, liver and kidney function
Iron, TI BC, Ferritin	Adequacy of Iron stores in anemia
B12 and Folate	Work up of anemia
PTH and 25 (OH) vitamin D	Adequacy of Calcium absorption
Lipid Panel	Estimate of malabsorption
HbA1C	Monitoring diabetic resolution
Measurement in symptomatic patients	
Vitamin A	May be low in malabsorptive procedures
Vitamin B1 (whole blood)	Elucidation of neurologic or cardiac symptoms, poor oral intake or vomiting
Vitamin B6	High alcohol intake
Trace elements (Zn, Cu, Se ,Mn)	Obscure symptoms, refractory anemia especially in non-compliant patients

Table 1. List of common nutritional factors measured during routine annual follow up in patients after bariatric surgery

an anastomosis to the adjacent bypassed stomach, usually with a linear stapler. The Roux limb can simply be excised, but in a malnourished patient it is preferable to divide the original J-J anastomosis and reanastomose the limbs to restore as much intestinal absorptive area as possible.

Sometimes these operations, despite the technical simplicity, result in serious complications with catastrophic deterioration and rapid development of multi-system organ failure. The cause of such deterioration has not been established but is presumed to be due to some critical micronutrient deficiency. The most likely candidate appears to be thiamine deficiency, and anecdotal evidence has confirmed that severe hypotension with lactic acidosis may be improved by rapid administration of thiamine 100mg IV.

4.3. Specific nutritional deficiencies

4.3.1. Iron, vitamin B12 and folate

Iron deficiency is very common after any bypass operation because the maximal site of Iron absorption, the duodenum and proximal jejunum, has been bypassed. It has also been observed after sleeve gastrectomy or LAGB. Other factors contributing to Iron deficiency are the frequent use of acid suppressants, the relatively small quantities of red meat consumed by bariatric patients, and the unpleasant GI side effects associated with elemental iron ingestion. Iron deficiency is naturally commoner in menstruating women. The symptoms of anemia are so

non specific – weakness, tiredness, exertional dyspnea – that measurement of routine indices is fundamental: consequently, anemia is easily and immediately recognized. Severe iron deficiency may be associated with pica, a compulsion to eat things such as crushed ice or even clay.

The treatment of iron deficiency requires replacement of iron and attention to reduce any factors exacerbating it: women with heavy menstrual losses should be referred to a gynecologist for management of menorrhagia, and acid suppression medication stopped if it is no longer necessary. Oral iron supplements are generally prescribed and include ferrous sulfate, ferrous gluconate, and ferrous fumarate. Ferrous glycine sulfate appears to have fewer side effects and the best bioavailability. Typical doses are tailored to achieve 60-100mg/day of elemental iron.

Intravenous iron supplementation may be necessary when oral iron is insufficient or cannot be tolerated. It is often administered by a hematologist in an infusion center because of concerns about allergic reactions. Intravenous iron must be complexed to other molecules to avoid iron toxicity. Iron Dextran is commonly employed. The risk of anaphylactic and other reactions is less than 1%, but recently Iron Sucrose has been used because the risk of allergic reactions is much lower (0.1%) and more recently still, Iron Carboxymaltose has been used because larger doses can be given in a short time (1000 mg over 15 minutes), making it much more convenient to administer [37].

Regardless of how iron is given, correction of anemia is a gradual process and it takes 1-2 months to restore iron and hemoglobin levels.

4.3.2. Vitamin B12 and folate

Vitamin B12 deficiency is fairly common because oral ingestion of B12 is ineffective in patients after gastric bypass, since the small gastric pouch produces so little intrinsic factor to complex with the B12 molecule. It is less likely to happen after duodenal switch or sleeve gastrectomy but it may still be present, and has been reported to be as high as 20% in some series. It typically presents a year or more after surgery because the liver has substantial reserves of B12.

Vitamin B12 deficiency causes megaloblastic anemia, which is readily correctable by restoration of B12 stores. Deficiency also predisposes to neuropsychiatric issues, causing peripheral neuropathy and symptoms of ataxia as a consequence of damage to the posterior columns of the spinal cord. There may be ataxia or inability to drive a vehicle because of loss of proprioception in the feet. These neurological symptoms may be irreversible, especially if present for longer than six months.

There is controversy about the cut-off point for the lower limit of normal for B12 levels. In USA the lower limit of normal is about 200 pg/ml, but there is concern that this level is too low and in Japan the lower limit of normal is now 550 pg/ml. In practice, it is easy to maintain healthy levels of B12 in compliant patients. Sublingual tablets permit rapid absorption without the need for intrinsic factor and are readily available over the counter in the USA. Monthly injections are also easy to administer and patients can be taught to administer such injections themselves.

Folate participates in the same pathway as vitamin B12 and is associated with similar hematologic and neurologic manifestations. It is easy to absorb and since it is a major component of multivitamin pills deficiency is rarely seen. In fact elevated levels of folate are frequently observed and generally indicate small intestinal bacterial overgrowth (SIBO).

4.3.3. Calcium and vitamin D

Calcium is another critical divalent cation which is absorbed proximally in the jejunum and may become deficient after bariatric surgery. Absorption of calcium requires vitamin D, a fat soluble sterol with many different properties. Vitamin D is initially hydroxylated in the liver to become 25 (OH) Vitamin D, and then converted to its active form, namely 1, 25 $(OH)_2$ Vitamin D in the kidney. Vitamin D is also produced by the action of UV light on the skin and in practice this is the major source of vitamin D. Vitamin D deficiency is common in northern latitudes where available sunlight exposure is limited, and also in certain ethnic subgroups where exposure of the skin to sunlight is limited for cultural reasons. Deficiency of calcium can often be detected clinically by a positive Chvostek sign, and biochemically is generally associated with elevated Parathyroid Hormone (PTH) levels.

Prolonged vitamin D deficiency causes osteomalacia, visible radiologically as loss of bone matrix, and clinically presenting with bone pain and predisposing to long bone or vertebral fractures. It also causes a proximal myopathy, especially in the muscles of the hip girdle, making it difficult to perform such simple activities as standing up from a sitting position. Typically patients rising from a chair will use their hands and arms to assist the activity, analogous to Gowers' sign observed in children with muscular dystrophy. These musculoskeletal symptoms are often dismissed as arthritis or fibromyalgia and it is important to make the diagnosis before the patient ends up being referred to a pain management clinic [38]. Vitamin D has many other advantageous qualities, including improved resistance to hospital acquired infections. [39]

Patients should have annual measurement of [25] OH Vitamin D and PTH. Low Vitamin D levels (< 30 ng/ml) require higher doses of Vitamin D than are typically present in multivitamin tablets (400 IU). The patient should have 50, 000 IU weekly and the level rechecked after 3 months. Parenteral Vitamin D is rarely required. Bone density measurements are generally within the purview of the primary care doctor, but the surgeon should regularly update and even educate the primary doctor about the patients' progress.

4.3.4. Vitamin A

Deficiency of Vitamin A is principally observed in malabsorptive operations such as DS or BPD, or the Long Limb gastric bypass. The clinical problems are chiefly ocular, and both the retina and the cornea are affected. The earliest manifestation may be night blindness, but corneal irritation and the development of Bitot's spots can also occur. There may be dry skin and dry hair and pruritus. The ocular manifestations are generally reversible when adequate supplementation is provided. The recommended dose is 10, 000 Units daily.

4.3.5. Vitamin B1

Water soluble vitamins, with the exception of vitamin B12, are not appreciably stored in the body and must be replenished regularly. Awareness amongst healthcare professionals and the lay public tends to promote the consumption of vitamin supplements and vitamin-rich foods, so that deficiency of water soluble vitamins is rarely a problem except in certain well defined groups. These include patients after bariatric surgery, alcoholics, and patients with short-gut syndromes. The importance of vitamin B12 and folate has been emphasized already. However, deficiency of vitamin B1 (Thiamine) has recently received considerable attention because it may present after periods of vomiting, such as can be frequent early after bariatric surgery of any type. A patient returning to the hospital because of intractable vomiting in the early weeks after bariatric surgery is at risk of developing thiamine deficiency. It can cause irreversible neurologic changes, with confusion, ataxia and nystagmus (Wernicke's encephalopathy) as well as heart failure [40].

Thiamine is an essential cofactor in the metabolism of glucose, and in its absence pyruvate cannot be processed in the citric acid cycle and is instead converted to lactate. The result is a serious metabolic derangement with lactic acidosis and hypotension requiring high doses of pressors. Such a patient is likely to be diagnosed with sepsis and given large volumes of fluid. Administration of dextrose in the IV fluids makes the situation worse because the glucose load cannot be metabolized. The patient should be given 200mg thiamine IV immediately and repeated daily until the patient can take a diet reliably. The cardiac failure may be rapidly improved by aggressive supplementation but the changes in Wernicke's encephalopathy may be permanent.

4.3.6. Rarer deficiencies: Vitamin B6, C, E, and trace elements

Other micronutrient deficiencies may involve other B vitamin deficiencies, but these are generally overshadowed by the major factors discussed above. Vitamins C and E have been found to be subnormal in some follow up studies after bariatric surgery. One recent report of an isolated case of severe scurvy described a patient with large confluent ecchymoses who developed multi-system organ failure, initially thought to be due to sepsis but which recovered after aggressive vitamin C replacement. Finally, there are isolated reports of trace element deficiencies, most notably Zinc, Copper and Selenium, which are important to consider in cases where unusual features of illness do not fall into a well-known pattern. Zinc deficiency appears to produce a scaly rash associated with edema. Copper deficiency produces refractory anemia and neurologic symptoms. It should always be considered in cases of refractory anemia which do not respond to iron and B12 and folate supplementation. Selenium has been implicated in a case of refractory heart failure after BPD. These micronutrients are usually a manifestation of lack of compliance since the necessary supplements are well absorbed and easy to obtain.

Taken together, these deficiencies have drawn attention to the profundity of the metabolic alteration which bariatric surgery and its altered eating behavior induces. They also emphasize the importance of facilitating long term follow up by knowledgeable providers. Prevention and management of most of these deficiencies is fairly simple when the patient remains in regular contact with the bariatric program. Regular follow up to inquire about eating habits

and obtain regular laboratory monitoring of nutritional status will prevent most serious problems. Ironically, patients who are doing poorly for whatever reason may be reluctant to return to the surgeon's office because of feelings of failure or shame and thus the patients most in need of expert help are the hardest to reach. This tendency should reinforce in bariatric programs the wisdom of offering ready access and a non-judgmental attitude.

4.4. Weight regain

Weight regain after initial weight loss can be thought of as the polar opposite of malnutrition. This is the emerging as the greatest threat in the long term management of the bariatric patient. There is no clear consensus on its incidence or severity, but it is estimated that upwards of 20% of patients will regain a large proportion of the weight initially lost, and re-enter the category of morbid obesity. Why some patients do this is not known, but the causes can be thought of in two broad categories: (1) surgical factors and (2) lifestyle factors. The major surgical factors are the size of the pouch and the size of the anastomosis. Where both are small, as they are generally made these days, regain of weight is reduced. Large pouches and wider anastomoses allow greater food intake with les satiety. Sometimes the pouch is larger than the surgeon intended because a hiatal hernia was present but unrecognized.

It is widely believed, largely on anecdotal evidence that behavioral factors are the most important factors in weight regain. Patients who do not use the "honeymoon" period (the first 6-12 months when weight loss is occurring rapidly) to bring about major changes in eating and exercise patterns will gain weight in subsequent years when the restriction has worn off. Sometimes the inability to eat leads to the development of other addictions such as alcohol. Other stressful social factors, such as divorce or loss of employment, may push the patient in the direction of her old habits.

The treatment of weight regain is very problematic from many points of view. There may be no clear anatomical explanation. Patients frequently request reoperation with great fervency, not realizing that the risk of serious complications may be up to ten times greater than that of the initial surgery. If there is no identifiable mechanical reason for the weight gain, reoperation may bring about some weight loss initially, but may only set the stage for weight gain once more. Further, insurance companies frequently deny requests for authorization to perform revisional bariatric surgery for weight regain. Only if an identifiable complication such as GERD is found will the company generally authorize it. The options are either to make the pouch and anastomosis smaller, or to convert the operation to a different type of procedure [41].

If there is no clear abnormality to correct, the surgical strategy has been whimsically summarized as "bypassing the band, and banding the bypass." Patients with unsatisfactory weight loss after LAGB may be converted to RNY GBP, but the risk of leakage is higher. Failure of the RNYGBP has been reported to respond to placement of a laparoscopic band round the gastric pouch to re-impose a sense of restriction. However both these strategies are only reported in case series with limited follow up and so are only recommended on an individualized basis [42, 43].

In concert with weight regain is the recent recognition that Type 2 diabetes sometimes returns. Even when it does, it is rarely as severe as it was preoperatively. The incidence is not known but it may be as high as 30% of patients who were diabetic and who experience relief early after surgery.

4.5. Psychiatric complications

Patients who are dependent on psychiatric medications may readily suffer exacerbation of their psychiatric conditions if early swallowing and eating difficulty prevents them from resuming their normal medications. Later in the evolution of the postoperative course, they may require increasing doses (particularly antidepressants) because the reconstructed intestine absorbs less, leading to lower blood levels of the medication. For this reason many surgeons attempt to prevent such a crisis by inserting a gastrostomy tube into the remnant stomach at the time of the original bariatric procedure and remove it only when the patient is reliably consuming essential medications orally.

Some patients who have a so-called addictive personality become obese because food acts as an addictive substance and after surgery such patients may develop so-called addiction transfer, and become addicted to alcohol, drugs, or gambling.

Although most patients note enhancement of their psychosocial functioning after major weight loss, it can result in serious interpersonal conflict within families and there is a substantial incidence of breakup within marriages and domestic partnerships [44].

4.6. The disappointed patient

Some patients even without experiencing a complication may nevertheless be disappointed in the outcome, either because their weight loss was less than expected, or weight was regained a few years later, or because of the appearance of large floppy folds of skin on the abdomen, under the arms, the medial thighs and buttocks. Although these can often be dealt with by plastic surgery, such operations are themselves prone to complications of infection and seroma formation. These problems emphasize the importance of preoperative counseling and creation of realistic expectations, and the provision of postoperative counseling to assist patients in maximizing the effect of such benefits as they have achieved.

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