The Complications of Bariatric Surgery

Koddus Ali[1]

[1]Department of Health and Life Science, Birmingham, United Kingdom

Correspondence to: Koddus Ali, Department of Health and Life Science, Birmingham, UK, email: koddus-ali@outlook.com

Abstract

Background: Obesity is a worldwide issue that is associated with both health and socioeconomic implications. Conventional obesity management strategies have failed to sustain weight loss in severely obese patients and are therefore short-lived. Currently, bariatric surgery appears to be the most promising form of effective treatment for severely obese patients. It is a safe and effective form of surgery that produces sustainable weight loss and alleviates obesity-related comorbidities.

Aim: The aim of this review is to explore the three types of bariatric surgery: Laparoscopic adjustable band (LAGB), Roux-en-Y gastric bypass (RYGB), Sleeve gastrectomy (SG), and their complications.

Method: The primary sources of literature for this review were acquired by searching MEDLINE (Ovid), Science Direct, and the Cochrane Library databases for associated articles to 14th February 2020. A combination of MeSH/Thesaurus terms and free-text terms were included in this search: bariatric surgery, gastric band, sleeve gastrectomy, adjustable gastric band, roux-en-Y gastric bypass, and obesity surgery.

Result: All three types of bariatric surgery have the potential to cause both mild and serious post-surgical complications. Although the most dominant and frequently performed bariatric surgery is the RYGB, the SG is an emerging and more favourable form of surgery for severely obese patients because of its tolerable morbidities and long-term weight loss.

Conclusion: Bariatric surgery is a safe and effective form of treatment for severely obese patients. The SG is becoming increasingly popular as a result of its favourable profile in maintaining weight loss and tolerable morbidities. The development of both early and late complications emphasises the importance of closely monitoring patients after bariatric surgery in order to detect any adverse events, as late complications may manifest as life-threatening emergencies.

Cite: Ali, K. (2020). The complications of bariatric surgery. *IRes Med J, 1,* (1) pp. 1 –12. https://dx.doi.org/10.5281/zenodo.4459941

Published Online: 20th October 2020

Introduction

Over the past decade, the prevalence of obesity has exponentially increased in all age groups in both developing and developed countries.[1] Obesity is a worldwide issue that has been attributed to serious health and socioeconomic implications. In 2000, it was estimated that 200 million adults were obese worldwide.[2] Currently, this figure has risen to 650 million adults being classified as obese. Additionally, there is an alarming rate of increase in childhood obesity.[3] Obesity is associated with many health conditions, including coronary heart disease (CHD), type 2 diabetes, hypertension, osteoarthritis, gastro-oesophageal reflux, and gallbladder disease.[4, 5] Although severe obesity has been associated with health complications, studies have reported that even a mild degree of obesity may be associated with health

complications, and consequently, reduce the longevity of life.[6, 7, 8] The burden of an increase in obesity worldwide has consequently led to an increase in mortality, associated with obesity-related health complications.[6, 9]

Although the National Health Service (NHS) has implemented a range of management strategies to manage obesity-related illnesses, it has cost the NHS 6.1 billion pounds between 2014 to 2015, and it is estimated to cost the NHS 9.7 billion by 2050.[10, 11] Bariatric surgery is a successful form of treatment in reducing weight in obese patients. There are three types of commonly performed bariatric surgery: Laparoscopic adjustable gastric band (LAGB), Roux-en-Y gastric bypass (RYGB), and Sleeve gastrectomy (SG).[12] While these three types of surgery have shown favourable results, each procedure possesses and induces certain postoperative complications that may manifest in early or late periods.[13, 14, 15, 16, 17] In this review we will explore the three types of bariatric surgery, LAGB, RYGB, and SG, alongside their complications.

Method

A search for articles exploring Bariatric surgery was performed. The following databases: MEDLINE (Ovid), Science Direct and the Cochrane Library databases were searched for associated articles to 14th February 2020. A combination of MeSH/Thesaurus terms and free-text terms were included in this search: bariatric surgery, gastric band, sleeve gastrectomy, adjustable gastric band, roux-en-Y gastric bypass, and obesity surgery. The search was restricted to articles published in English. A hand-search of reference lists of studies meeting the inclusion criteria were also conducted.

Conventional management strategies for obesity

Currently, there is a widespread usage of dietary, therapy, and drug treatment in overcoming obesity. However, these methods of treatment have been shown to be short-lived.[18, 19] Weight loss through dietary means is achieved by a low-calorie diet, the concept is to reduce energy intake below the energy expenditure level.[20] Although diet can reduce body weight by 8% in a period of 3-12 months, the long-term results of maintaining the intervention have been reported to be 4% of weight loss over a period of 3-4 years. These figures are much lower than the expected 10% of bodyweight sustenance for more than 1 year.[21]

Physical activity is another conventional method of managing obesity. Although physical activity is essential in maintaining weight loss, this alone can only achieve modest amounts of weight loss.[22] Since changes in weight are affected by energy expenditure versus the amount of energy consumed, the combination of both dietary and physical exercise has been shown to be more effective in weight loss when compared to diet or physical activity alone.[22, 23] Evidence suggests that physical activity in combination with diet is necessary to prevent weight gain, with recommendations of 225-300 minutes of physical activity per week to prevent the transition from normal weight to obese.[24]

Currently, the clinical evidence of pharmacotherapy for treating obesity suggests that most drugs have an efficacy of 3-7% weight loss and consist of side effects. Additionally, there is usually the issue of patient compliance.[25] Although pharmacotherapy is of great utility in maintaining weight loss, discontinuation of therapy may lead to individuals regaining weight.[25] Nevertheless, orlistat, phentermine plus topiramate, lorcaserin, naltrexone, bupropion, and liraglutide have all been reported to significantly reduce body weight.[26] However, obesity is multifactorial; a combination of treatment may be necessary with the purpose of targeting more than one pathogenesis factor.[27]

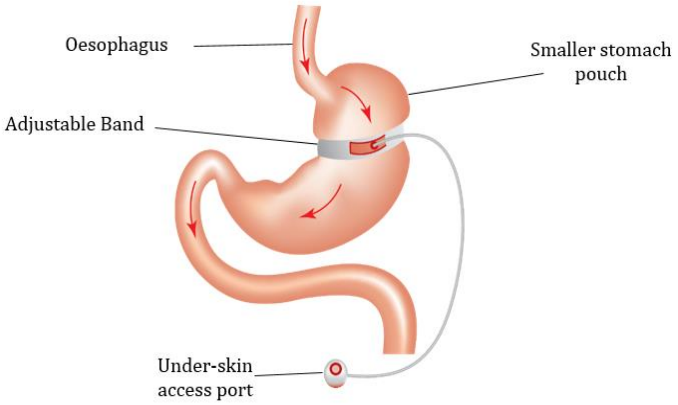
Bariatric surgery

Bariatric surgery is a procedure that has proven to be effective in reducing body weight in obese patients.[28] The surgical procedures are categorised into three groups: malabsorption, restriction, or a combination of both. Bariatric surgery is usually performed on obese patients that have failed to respond to non-surgical interventions, with significant reduction in obese related comorbidities.[29] In the past decade, the UK has perceived an increase in the rate of bariatric surgery performed; it is increasingly being performed in men and women between the ages 35 and 54 years.[30] The surgery has been demonstrated to reduce the requirement of pharmacotherapy, incidence in new diabetes, mortality, and improve the quality of life.[31, 32]

Laparoscopic adjustable gastric band

One of the most common bariatric surgery procedures performed on obese patients is the LAGB (fig. 1).[33, 34] The LAGB is a restrictive procedure that is reversible and is one of the least invasive procedure.[29] The surgery is performed using a silicone adjustable band that is placed near the upper stomach, around 1 cm below the oesophagogastric junction.[35] The silicone band is then connected to the subcutaneous port for the purpose of adjustments.[36] This procedure restricts the quantity of food the stomach can hold, therefore reducing appetite and creating a sense of satiety.[36] Although LAGB is one of the least invasive bariatric surgical procedures, the use of LAGB has declined because of its complications.[16]

Figure 1. Laparoscopic adjustable gastric band



Gastric Band Slippage

While LAGB is frequently performed in the UK, the surgery has been reported to cause postoperative complications. The typical complications of LAGB surgery are gastric stomal stenosis and obstruction caused by gastric band slippage.[37] The slippage of the band is usually caused by abnormal positioning or recurring vomiting.[38] In acute stomal stenosis, where there is a blockage of the stoma by food, or in postoperative stomal edema, the patient may endure upper abdominal discomfort, vomiting, and nausea. Unaddressed acute stomal stenosis may lead to chronic stomal stenosis.[37, 39, 40] In chronic stomal stenosis, weight loss and severe gastroesophageal reflux may occur and have been observed in 4-13% of patients.[40] The diagnosis of band slippage may be complicated as the slippage may be intermittent.[41]

Gastric band erosion

Gastric band erosion is a potential serious complication in LAGB surgery, with the incidence reported to be between 0.3% and 28%.[41] The wide range in the incidence of gastric erosion is postulated to be as a result of the variation between institutions in their follow-up routine imaging of patients.[42] The occurrence of gastric band erosion is proposed to be in either the early stages or postoperative period, and is suggested to be multifactorial.[14, 15] The cause of gastric band erosion has been reported to be as a result of continuous pressure of the gastric band against the gastric wall, micro-perforation, postoperative infection, formation of adhesion, or foreign body rejection.[37]

Intragastric band migration

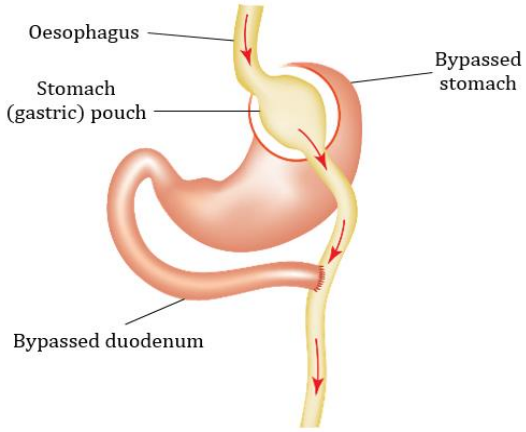
Intragastric band migration after erosion is a rare complication that has been reported in 0.3% to 14% of patients.[44, 45] Although intragastric band migration is typically a delayed complication, reports suggest that it has been detected as early as 12 months in postoperative patients.[16] The complication is a chronic insidious process and patients are usually asymptomatic. However, patients that are symptomatic typically manifest symptoms of vague epigastric pain, haematemesis, and cessation of weight.[46, 47] Although the bands are intragastric, there are cases of the band migrating into the abdominal cavity, and in certain cases, to the rectum, leading to transient large bowel obstruction.[48, 49]

Roux-en-Y gastric bypass

RYGB, also referred to as gastric bypass, is currently one of the most commonly performed bariatric surgery in the UK (fig. 2).[50] The surgical procedure is performed laparoscopically, with the creation of a small pouch to separate the rest of the stomach. A vertically oriented (-30ml) gastric pouch connected to the jejunum forms the Roux limb.[51] The jejunum is divided into two limbs, with the disconnected duodenal limb anastomosed to the gastric pouch, while the upper limb is attached lower down the jejunum, forming the Y configuration, bypassing the distal stomach duodenum and a portion of the proximal jejunum.[52, 53] The outcome is a small pouch that is restrictive and holds a small amount of food,

resulting in malabsorption because of the bypassing of the proximal small bowel.[54, 55, 56]

Figure 2. Roux-en-Y Gastric Bypass



Malabsorption

Malabsorption is one of the mechanisms of success in weight loss with the RYGB surgery, occurring as a consequence of restricting the food intake via bypassing the proximal small bowel.[54,56] The concept of malabsorption is to bypass the absorptive capacity of the intestine and furtively remove calories through faeces. [57] Therefore, dietary supplementation begins immediately post-surgery, while the patient is in the hospital, to maintain essential dietary needs. However, adverse effects have been reported to develop months after the surgery.[58] These adverse effects may be due to patient compliance or diligence in monitoring nutrient deficiencies by clinicians.[59, 60]

Nutritional deficiency

RYGB is a successful restrictive surgical procedure, using malabsorption as a mechanism to reduce weight. However, as a consequence of malabsorption, patients are required to supplement with vitamins and minerals to prevent nutrient deficiencies.[61, 62] The most common vitamin and mineral deficiencies that may develop are iron, copper, calcium, B12, folate, and vitamin D.[63] Nutritional deficiencies can present and manifest into a wide range of complications depending on the specific nutrient. Nutrient deficiencies can cause mild or serious complications in patients and may lead to life-threatening emergencies.[64] Therefore, clinicians are required to closely monitor patients' nutrient status before and after surgery; iron levels are of particular importance since patients that have undergone bariatric surgery have been shown to be at increased risk of anaemia.[65]

Dumping Syndrome

A common side effect of RYGB is dumping syndrome. This side effect has been reported to occur in 90% of patients post-gastric bypass, with characteristics of light-headedness, sweating, diarrhoea, and epigastric fullness after ingesting fatty, sugary, or dairy products.[66, 67, 68] Once patients acknowledge the types of foods they are able to tolerate, the side effects usually subside.[66, 68] Early dumping is attributed to gastrointestinal symptoms that may include nausea, diarrhoea, abdominal pain, and bloating.[69] These symptoms are usually observed in the first hour after a meal and are postulated to be as a result of the hyperosmolality of the food, and fluid that is moving from the plasma compartment to the intestinal lumen, causing hypotension and sympathetic nervous system response.[17, 70] Late dumping syndrome is characterised by an incretin-driven hyper-insulinemic response after the intake of carbohydrates. Hypoglycaemic symptoms are commonly related to neuroglycopenia and autonomic/adrenergic reactivity.[17, 70]

Although dumping syndrome may occur in early or late periods, it may be the case that patients develop both early and late dumping syndromes concurrently.[17, 70] In some patients, these symptoms may persist for many years' after surgery and can result in weight loss or weight gain.[71] The management of dumping syndrome initially addresses dietary modification and supplements.[72, 73, 74, 75] The second option is pharmacological intervention; patients are prescribed acarbose or somatostatin analogues.[76, 77, 78] Surgical re-intervention or continuous enteral feeding may be considered in addition to therapeutic approaches for patients that continue to experience dumping syndrome. [79, 80]

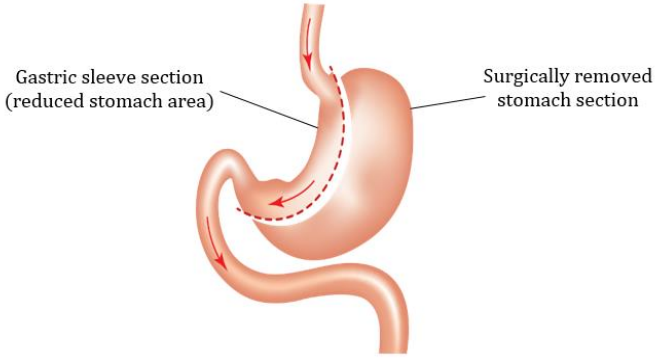
Small bowel obstruction is a medical emergency that can manifest as chronic or acute, causing life-threatening emergencies.[81] The cause of small bowel obstruction post-RYGB surgery may be due to an internal hernia or, less commonly, as a result of intraluminal clots and strictures.[81] The development of an internal hernia is associated with multiple defects in the mesentery of the bowel.[82] The diagnosis of a postoperative internal hernia

may be challenging, as physical examination of the abdomen may show no apparent signs of abdominal distention; hence, diagnosis is often delayed.[83] Patients that have an internal hernia post-gastric bypass typically report persistent non-specific colicky mid-epigastric or periumbilical pain, with the pain radiating to the back.[83] These symptoms may be complicated with other medical conditions, such as peptic ulcer disease, gastroenteritis, and pancreatitis.[83]

Sleeve gastrectomy

SG is the removal of 60-80% of the stomach, leaving a restrictive 'sleeve'-shaped organ (fig. 3).[54] The procedure was first described as the modification of biliopancreatic diversion-duodenal switch.[53, 54] This type of bariatric surgery is becoming increasingly popular in comparison to RYGB as a result of its acceptable morbidity and long-term weight loss.[84, 85] In addition to the maintenance of long-term weight loss, the advantage of SG is that no intestinal bypass is performed. Thus, the complications of intestinal hernia, gastrointestinal anastomoses, and metabolism derangement are not a concern.[86]

Figure 3. Sleeve Gastrectomy



Acid reflux disease

The favourable profile of SG has made it one of the most popular type of bariatric surgery, especially in higher risk patients.[87, 88] However, unlike RYGB surgery that mitigates acid reflux symptoms, SG has been reported to increase acid reflux in patients.[89, 90] Although there are controversies regarding patients developing acid reflux after surgery, current recommendations suggest that patients with a history of acid reflux disease should not undergo SG.[89, 90, 91, 92] Nevertheless, the key advantage of SG is that the surgery can be reversed to RYGB, in the case of weight loss failure or severe acid reflux.[93]

Staple line leak

Similar to LAGB and RYGB, SG is not without its complications. One of the most feared complications of SG is the staple line leak at the oesophagogastric junction.[94] The prevention of this complication remains challenging, requiring multidisciplinary technical platforms including digestive endoscopy, intensive care unit, and radiology.[95] The incidence rate of staple line leak at the oesophagogastric junction is reported to be 0.74%, and it is the second most common cause of death after SG, with an overall mortality rate of 0.4%.[96, 97] The pathogenesis of leakage is suggested to be correlated to mechanical or ischaemic causes. However, it is not clear if the leakage is technical or patient-related that can predispose the patient to leakage.[97]

In the case of a staple line leak, staple line reinforcement has been proposed to be an option in decreasing the risk of further complications.[98] There are several options when pursuing the staple line reinforcement procedure, including roofing the staple line, over-sewing the staple line with a running absorbable suture, and buttressing it with specific materials.[95] The use of staple line reinforcement has been shown to be successful in reducing postoperative bleeding; the main advantage appears to be improving the staple line strength and better sealing of the blood vessels on the gastric wall.[98, 99] Although there are controversies in the use of staple line reinforcement, a comparison of the reinforcement of the staple line procedures showed that reinforcing the staple line with over-sewing increases staple line haemorrhage, whereas reinforcement with a buttress decreases staple line haemorrhage.[98, 100, 101]

Gastric balloon

Gastric balloon procedure is considered to be a less invasive and reversible, non-surgical procedure for severe obese individuals; it is an intermediate alternative between medical obesity treatment and bariatric surgery.[102] The procedure involves inserting an empty silicone balloon into the stomach through gastroscopy with general anaesthetic.[103] The balloon is then inflated with saline or air in varying volumes.[104] The concept of the gastric balloon is to reduce the stomach volume, making patients feel satiety and consequently reducing food intake and inducing weight loss.[103] The insertion of

the gastric balloon is a temporary procedure and it is removed after 6 months.[104] The procedure may be used as a psychological assessment of the patient in tolerating permanent bariatric surgery or to avoid surgical risks.[105]

Although the gastric balloon technique is an effective method of reducing weight in obese individuals, there are numerous adverse effects associated with this procedure.[106] The adverse events reported with intragastric balloon include gastric ulcer, gastroesophageal reflux disease, nausea, and pain.[107] While serious adverse events are uncommon, gastric perforation (0.1%), migration (1.4%), and death (0.08%) have been reported.[107] However, complications of gastric perforation (0.1%) and bowel obstruction (0.3%) have been reported to be as a result of how the balloon was implanted, the duration for which it remained, and its removal procedure.[108]

Discussion

In this review we have explored the complications of the different types of bariatric surgery. The findings suggest that bariatric surgery is a proven approach in reducing weight in obese patients. Each of the surgical procedures explored in this review pose some form of adverse effects. However, the benefits usually outweigh the risks to obese patients, as the alternative is the risk of further health complications that may lead to mortality. Amongst the three different types of bariatric surgery explored in this review, SG appears to be one of the most popular surgical option, with fewer adverse effects and being the least invasive procedure.

Despite the decline in the popularity of LAGB across several countries, LAGB remains a viable bariatric surgical option in the UK.[109] The decline in the popularity of LAGB is mainly due to its adverse effects, with the potential of causing life threatening complications.[109] The common severe complications reported in the literature are gastric band slippage, gastric band erosion, and intragastric band migration.[37, 38, 41] All three of these adverse effects of LAGB present significant life-threatening complications to patients.[67, 107] However, the number of cases that have been reported for these incidences are minimal.[41, 96, 97, 107] Nevertheless, the overall existing literature on LAGB suggests that the procedure is safe and effective; whether LAGB remains a viable surgical option in the future has yet to be determined.

The alternative option to LAGB is the RYGB surgical procedure. Currently, RYGB is the most commonly performed bariatric surgery in the UK.[50] However, there have been several concerns regarding the complications of RYGB surgery. The most dominant concern is the inadequate nutrient intake.[63] Malabsorption is a huge concern in patients that have undergone this form of surgery. Although these adverse effects can be adequately maintained when detected, they may pose significant threats to patients. One major concern of RYGB is the risk of small bowel obstruction, manifesting as chronic or acute and causing life-threatening emergencies.[81] Evidence presented in this review suggests that the development of small bowel obstruction is due to internal hernias and, less commonly, intraluminal clots and strictures.[81] The difficulty in detecting these conditions has been elucidated to be as a result of the similarity of the symptoms across other conditions, such as peptic ulcers and gastroenteritis.[83]

In comparison to RYGB surgery, SG is a safer and reversible surgical procedure. Its popularity as a surgical option for obese patients is rising. SG has shown favourable results in maintaining long-term weight loss with fewer morbidities in comparison to RYGB and LAGB surgery.[84, 85] SG requires no intestinal bypass and therefore fewer adverse events and complications are present in this form of surgery. However, it is important to mention that SG is not without its adverse effects. As established in this review, patients that undergo SG may develop acid reflux disease or staple line leakage, a life-threatening complication.[89, 90, 96, 97]

Although the development of acid reflux disease is controversial, it is recommended that those with prior acid reflux disease should not undergo SG.[90, 91, 92] However, the main concern regarding this surgical option is the staple line leak complication. Although the cause of the staple line leak is unknown, the staple line leak may be reinforced with roofing the staple line, over-sewing with a running absorbable suture, or buttressing it with specific material.[95] The most favourable results

appear to be reinforcing the staple line with a buttress.[98, 100, 101]

While the gastric balloon is a non-surgical, less invasive, and reversible procedure, we have explored this procedure in this review. The concept of the gastric balloon is to reduce the stomach volume and create a sense of satiety. As mentioned in this review, the procedure may be used as a precursor to surgical options, assessing the psychological impact and tolerability of the patient prior to permanent surgery.[105] Serious adverse effects of gastric balloon are uncommon. However, there is evidence which suggests the potential risk of bowel obstruction; therefore, close monitoring may be essential to avoid this phenomenon.[108]

Certain limitations are present within this review. Firstly, due to the lack of studies available we were unable to establish whether acid reflux is a complication that manifests before or after surgery, as there appears to be contradicting evidence in this particular area. Secondly, we were unable to clarify the period of time it took for patients to develop certain complications after undergoing bariatric surgery. It is not clear from the literature whether certain complications manifested early or late because of the variation between the institutions in the routine follow-up imaging of patients.

In conclusion, all three bariatric surgical procedures are safe and effective in inducing weight loss in obese patients. However, each of these surgical options have both mild and potential serious complications. The most favourable of the three is SG; its popularity has increased in the past decade as a result of its ability to maintain long-term weight loss and its fewer morbidities. The development of both early and late complications emphasises the importance of close monitoring of patients after undergoing bariatric surgery to detect any adverse events, as late complications may manifest as life-threatening emergencies.

Conflicts of interest: None declared

Funding: No direct or indirect funding was received.

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