Chapter

Causes of Intestinal Obstructions after Roux-En-Y Gastric Bypass

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Abstract

Obesity is a global pandemic and bariatric surgery is one of the fastest-growing surgical procedures performed worldwide. Roux-en-Y gastric bypass (RYGB) remains one of the most commonly performed bariatric procedures, with more than 480,000 procedures performed in 2022. The RYGB is characterized by a small proximal gastric pouch that is divided and separated from the distal stomach and anastomosed to an alimentary limb of the small intestine, thus bypassing a large portion of the small intestine preventing the absorption of nutrients. Small bowel obstruction after gastric bypass is not uncommon; the internal hernia is the most common etiology followed by postoperative adhesions, although there are less common causes. Diagnosis can be challenging due to the altered anatomy of the gastrointestinal tract; CT imaging is frequently used to establish the diagnosis. Since an internal hernia can be a life-threatening situation, early treatment is critical. The management of internal hernias after RYGB remains surgical. The urgency of surgical intervention depends on the clinical condition of the patient. Surgery should be attempted laparoscopically first if possible.

Keywords: bariatric surgery, internal hernia, intestinal obstruction, obesity, gastric bypass, roux-en-y

1. Introduction

Obesity is a worldwide pandemic, nearly every country in the world is affected by it and its increased prevalence shows no significant signs of slowing down any time soon. It is estimated that over 4 billion people may be affected by overweight and obesity by 2035, compared to over 2.6 billion in 2020 [1]. This reflects an increase from 38% of the world's population in 2020 to over 50% by 2035 [2].

The World Health Organization (WHO) defines overweight and obesity as excessive fat accumulation that may impair health [3]. A broader definition of obesity would encompass a chronic, systemic, multi-organ, metabolic, and inflammatory disease expressed phenotypically by an excess of body fat.

Overweight and obesity are well-known risk factors for other diseases like diabetes mellitus, cardiovascular disease, and several types of cancers [4] including breast, colon, endometrial, and prostate cancer [5]. Other major comorbidities include degenerative joint disease, obstructive sleep apnea, and cholesterol gallstone disease [6],

all of which have a major bearing on life expectancy, quality of life, and mental health on an individual level, and detriment in work productivity and healthcare costs at a population level.

2. Bariatric surgery

Bariatric surgery is a medical specialty dedicated to the surgical treatment of obesity and its comorbidities. It is one of the fastest-growing operative procedures performed worldwide, with an estimated >480,000 operations performed by 24 countries in 2022 according to the 8th Global Registry Report of the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) [7].

In 1991, the U.S. National Institutes of Health (NIH) created a Consensus Conference that established the patient selection criteria for undergoing bariatric surgery [8]:

- BMI >40 kg/m2
- Or BMI >35 kg/m2 with comorbidities related to obesity.
- ≥18 years of age

Thirty years later, in 2022, with evidence of good outcomes, a decrease in morbi-mortality, improvements in patient safety, and development of laparoscopic techniques, the IFSO wrote major updates to the 1991 guidelines [9]:

- BMI >35 kg/m2 regardless of presence, absence, or severity of comorbidities.
- Metabolic disease and BMI of 30–34.9 kg/m2
- Appropriately selected children and adolescents should be considered for surgery

The physiology of digestion and nutrient absorption must be comprehended in order to understand the fundamentals of bariatric surgery. As the chime passes through the duodenum, pancreatic enzymes break down peptides and carbohydrates, and lipids are degraded by the pancreatic lipase and bile. Those nutrients are absorbed by the enterocytes and transported to the liver. More than 75% of carbohydrates, proteins, and fats are normally absorbed within 70 cm of the small intestine [10].

Bariatric malabsorptive procedures divert the flow of bile and pancreatic enzymes from food, thereby avoiding digestion of nutrients in the most proximal part of the GI tract where absorption is greater, resulting in reduced caloric intake.

Restrictive procedures, on the other hand, reduce the size or storage capacity of the stomach to induce satiety with less food, therefore reducing calorie consumption.

Malabsorptive/restrictive (mixed) procedures use both mechanisms: a restrictive component to initiate rapid weight loss, combined with a malabsorptive component to ensure long-lasting effects.

According to IFSO [7], the sleeve gastrectomy is the most commonly performed primary procedure (defined as the first procedure a person with obesity undertakes as a treatment for their obesity) in the majority of reporting countries, accounting

for 63.3% of the total number of registered procedures. With 28.8% of procedures, Roux-en-Y gastric bypass (RYGB) was the second most common primary procedure. In contrast, Roux-en-Y gastric bypass is the most commonly performed revisional metabolic bariatric procedure. The revisional procedures are those performed to change one type of bariatric procedure to another bariatric procedure, most often secondary to a failure of the primary procedure either due to weight gain, side effects of the initial procedure, or recurrence of metabolic disorders [11]. Nearly half of the revisional procedures correspond to RYGB.

3. Roux-en-Y gastric bypass

As discussed above, RYGB is the second most common bariatric procedure performed today and has long been considered the "gold standard" of bariatric surgery. Although originally performed as an open procedure, it is now almost exclusively performed using a laparoscopic approach.

It is important for the non-surgical healthcare professional to have a basic understanding of the surgical technique involved in creating a gastric bypass, as altering the gastrointestinal (GI) anatomy can lead to potentially serious complications that may be life-threatening to the patient.

RYGB is a restrictive-malabsorptive (mixed) procedure that creates a small gastric pouch that connects directly to the small intestine. **Figure 1**. This pouch is created by dividing the stomach into two parts. The first one is the most proximal and receives up to 30 ml of food, the second is the remaining stomach and does not receive food. The surgery also involves dividing the small intestine at a distance of 50 to 150 cm distal to the ligament of Treitz. The division of the small intestine creates two limbs, the first one is the "biliopancreatic limb" which transports the secretions of the gastric

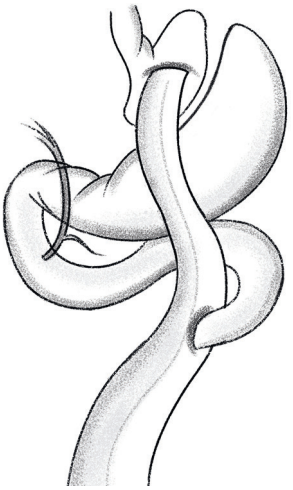

Figure 1.
Schematic representation of a Roux-en-Y gastric bypass. The gastric pouch is anastomosed to the alimentary limb. The digestive juices of the remaining stomach and biliopancreatic secretions are carried through the biliopancreatic limb. Note the site where the two limbs join. Swallowed food bypassed a portion of the small intestine.

remnant, liver, and pancreas; and the second limb or "alimentary limb" which is anastomosed at one end to the gastric pouch and the biliopancreatic limb at the other end. The distance between the two anastomoses is generally 75 to 150 cm. The connection of the biliopancreatic and alimentary limbs forms a common duct where pancreatic enzymes and bile mix with ingested food.

The surgical technique has two variations depending on the passage of the alimentary limb. In the retrocolic technique, the limb is passed through a mesocolic window (creating the Petersen's defect), whereas in the anterocolic approach, the limb is localized anterior to the colon. As discussed below, this difference in surgical technique creates more or less mesenteric defects that may result in a higher incidence of complications.

In summary, RYGB creates a small gastric pouch that restricts food intake and connects it to another distant portion of the intestine, which bypasses a large portion of the small intestine preventing the absorption of nutrients until they reach the distal part of the intestine where the "common duct" connects the two limbs.

In addition to promoting weight loss through a restrictive and malabsorptive mechanism, RYGB induces other physiologic changes in GI hormone secretion, intestinal bacterial colonization, bile acid metabolism, and epigenetic changes [10].

The restriction of food passage through the duodenum and jejunum in RYGB is thought to induce changes in postprandial gut hormone secretion [12]. For example, there is a decrease in the levels of gastrin, a peptide hormone that stimulates the secretion of gastric acid and aids in gastric motility. The appetite-stimulating hormone ghrelin is also suppressed postoperatively, as is cholecystokinin, which slows gastric emptying and suppresses hunger.

The vast majority of bile acids are reabsorbed in the terminal ileum and reused by the liver, forming the "enterohepatic circulation". In patients with RYGB, the biliopancreatic limb shortens the route for bile acids to reach the ileum, resulting in more active bile acid reabsorption [13]. This increased luminal bile acid concentration has antibacterial effects, killing certain strains of bacteria and allowing others to survive, although the contribution of the gut microbiota to the metabolic benefits after bariatric surgery has not been elucidated [14].

Finally, epigenetic markers are chemical modifications mediated by DNA enzymes that regulate genomic functions. Several studies have shown DNA methylation in adipose or muscle tissue after RYGB [15], which may explain the changes in physiology and metabolism after bariatric surgery.

4. RYGB complications that produce intestinal obstruction

RYGB is a procedure with a mortality of 0.5% and a morbidity of 7 to 14% [16]. It is not uncommon for patients to present to the emergency department with abdominal pain after RYGB, so the general practitioner must be aware of the unique complications of this type of surgery in order to make a prompt diagnosis and avoid delaying treatment with potentially fatal consequences.

Small bowel obstruction (SBO) is a common complication of RYGB with a lifetime incidence of 6 to 9.6 percent [17] and is one of the most feared complications since it can become a life-threatening situation.

The etiology of SBO has numerous causes which makes differential diagnosis particularly difficult. Among the diverse etiologies, the most frequent are internal hernia, postoperative adhesions, anastomotic stricture, incisional hernia, and intussusception. 60% of SBO after a RYGB is due to an internal hernia [18].

4.1 Roux-en-O misconstruction

One cause of SBO early after surgery (<30 days postoperative) may be the misidentification of the alimentary and biliopancreatic limbs during surgery, resulting in a loop obstruction as the distal jejunum of the biliopancreatic limb is anastomosed to the gastric pouch. A condition known as "Roux-en-O misconstruction" requires a second surgical intervention to correct the mistake.

The clinical presentation encompasses abdominal pain, nausea, and bilious vomiting. It is an extremely difficult diagnosis to make, as radiological modalities may appear normal.

4.2 Internal hernia

An internal hernia (IH) is the protrusion of the bowel through the mesenteric defects created by the division of the small bowel to form de biliopancreatic and alimentary limbs or the defect in the mesocolon when a retro colic roux limb technique is used. The incidence of IH is higher in the laparoscopic technique rather than in the open approach due to lesser postoperative adhesions.

The IH is the most common long-term complication after Roux-en-Y gastric bypass with an incidence of 12% without routine closure of the mesenteric defects [19] and between 0.9% and 4.5% [20] when mesenteric defects are closed with non-absorbable sutures. It often presents as a late complication (>30 days postoperative) of surgery.

There are three potential spaces for internal hernia formation in an RYGB depending upon the surgical technique used, as illustrated in **Figure 2**. When an antecolic RYGB is performed, only two spaces are created: a mesenteric defect at the jejuno-jejunostomy (also known as Brolin's space) and a space between the transverse mesocolon and Roux limb mesentery (Petersen's defect). If a retro colic roux limb technique is used, another space is added: a defect in the transverse mesocolon [21]. The incidences of IH in each space vary among studies.

The clinical presentation of late SBO is variable, ranging from mild digestive symptoms to acute abdomen. The reducibility of the hernia, the presence or absence of strangulation, and incarceration all influence the severity of the symptoms. Abdominal pain is the most common complaint [22], often described as deep, continuous, and gradual onset, with the majority of patients localizing the pain in the left upper quadrant of the abdomen. Few patients report changes in bowel frequency.

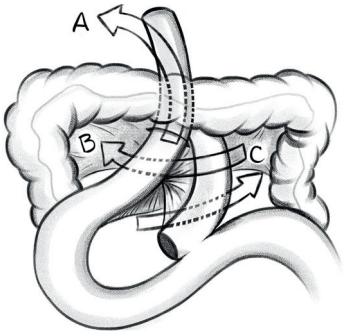

Figure 2.
Schematic representation of potential sites for internal hernia formation. (A) Defect in the transverse mesocolon, (B) Petersen's space, and (C) Brolin's space.

Nausea and vomiting are less common, with less than half of patients experiencing these symptoms [23], due to lack of involvement of the alimentary limb.

Because clinical diagnosis is difficult, imaging studies play an important role in the evaluation of patients with high clinical suspicion. Abdominal computed tomography (CT) is the preferred imaging modality for the diagnosis of IH prior to surgery, as its sensitivity and specificity has been reported to exceed 80% [24]. Traditionally, three signs have been described [25] with variable diagnostic sensitivity and specificity. The "swirl sign", which is considered the best predictor of IH, consists of the twisted appearance of vessels and fat at the mesenteric root; abnormal clustered loops; and the "mushroom sign", which is formed by the herniated mesenteric root in a mushroom shape with mesenteric vessel stretching.

Other authors have proposed additional signs such as the small bowel (other than duodenum) posterior to the superior mesenteric artery and right-sided location of the distal jejunal anastomosis [26], or the "superior mesenteric vein (SMV) beaking" [27] which consists of decreased caliber of the SMV. Although no sign alone is pathognomonic of IH, prompt interpretation of CT may lead to an early diagnosis and prompt treatment of a potentially serious complication like ischemia, necrosis, or perforation of the involved intestinal segment. However, diagnostic laparoscopy should be performed immediately if there is any doubt in the imaging studies or if the patient is critically ill.

Surgical exploration is recommended for bariatric patients suspected of having IH. Either open or laparoscopic exploration can be performed, although the latter can be technically challenging due to bowel dilatation which increases the risk of injury during trocar placement and also decreased working space.

In both cases, the recommended first step of the procedure is to identify the ileocecal valve and explore the terminal ileum (the common channel) toward the ligament of Treitz until the jejuno-jejunostomy is reached [28]. The potential mesenteric gap at the jejuno-jejunostomy is then explored. The biliopancreatic and alimentary limbs are identified and explored, as well as Petersen's space and the gap between the transverse mesocolon (in cases where the retrocolic technique was used). All the intestine trapped within the hernia defect should be carefully reduced with atraumatic forceps to avoid iatrogenic injury. Once all the herniated bowel has been reduced, it should be carefully examined to determine perfusion. If perfusion is compromised or frank necrosis is encountered, resection with primary anastomosis is required [21].

It is very important that all mesenteric defects are carefully examined and closed with non-absorbable sutures if found open, as there is a 14% risk of recurrence of IH in the untreated mesenteric gaps [29]. As for the rates of IH in the antecolic vs. retrocolic technique, the latter have a lower incidence (1.3% vs. 2.3%), since there is a smaller number of mesenteric defects [30].

Because IH is a relatively common complication of RYGB, a single anastomosis procedure called open gastric bypass (OAGB) has been developed to reduce the incidence of IH. The OAGB eliminates the mesenteric defect in Brolin's space due to the absence of the jejuno-jejunostomy, although the risk of Petersen's hernia remains, with an incidence of IH of 2.8% [31].

4.3 Intussusception

Intussusception after RYGB is a rare late complication of RYGB, with an incidence ranging from 0.15 to 4.7% [32]. It is thought to originate from motility disorders in the divided small intestine, secondary to the disruption of the natural intestinal

pacemakers in the duodenum, and allows for the formation of ectopic pacemakers in the alimentary limb [33].

Most intussusceptions after RYGB occur at the jejuno-jejunostomy site and are retrograde (antiperistaltic) [34], telescoping the distal bowel segment into the proximal segment. If left untreated, it may progress to bowel ischemia and wall necrosis.

Clinical presentation includes abdominal pain, constipation, nausea, and vomiting, with or without signs of acute abdomen. The most useful diagnostic tool is the CT, which shows the classic "target sign" (concentric rings) [35].

Most patients require surgical intervention. If exploration of the jejuno-jejunostomy reveals ischemic bowel or perforation, bowel resection is mandatory. If the exploration reveals no complications, it can be treated with a reduction of the bowel segment without resection, although this approach has a risk of recurrence, so some authors suggest that the invaginated segment should be resected whether it is viable or not [36].

4.4 Bezoars

A bezoar is a combination of ingested materials that cannot be digested and are therefore retained in the GI tract. They are classified according to their composition, with phytobezoars (composed of plant fibers) being the most common type [37]. They are a rare etiology of bowel obstruction after RYGB, accounting for <1% of cases [38].

Most patients have a history of gastro-duodenal surgery [39] resulting in altered GI anatomy and/or motility. Bariatric surgery may promote bezoar formation due to small gastric pouches, decreased gastric motility and acidity, and narrow stomas at anastomoses [40]. The most common location of bezoars is the stomach, although the bezoar may migrate to the small or large intestine [41].

Reported sites of intestinal obstruction after RYGB include the gastric pouch, the gastrojejunostomy, the alimentary or biliopancreatic limb, or, extremely rarely, the jejuno-jejuno anastomosis [42].

Clinical presentation varies depending on the location of the bezoar but often includes nausea, vomiting, and/or symptoms of gastric outlet obstruction. If complicated by GI bleeding from ulcer or wall necrosis (secondary to increased intraluminal pressure), they may present with anemia, bloody stools, or hematemesis [43]. If perforation is present, the patient will develop signs of acute abdomen.

Diagnosis requires a high index of suspicion. Plain radiographs may show radiotranslucents, ultrasound can show the presence of an intraluminal mass with a hyperechoic surface and prominent acoustic shadow, CT can show a round intraluminal mass in the GI tract with retained air bubbles inside, endoscopy is the preferred method as it allows direct visualization of the bezoar and allows therapeutic applications [40, 42, 43].

Current treatment options include chemical dissolution of the bezoar (in the absence of SBO) with Coca-Cola [37] or papain [44], an enzyme extracted from the Carica papaya plant and used in some meat tenderizing products. Endoscopic fragmentation and removal are also possible. In the case of SBO or ileus due to bezoar, surgical removal is indicated via enterotomy [43] or the milking technique, which consists of pushing the bezoar toward the stomach or through the ileocecal valve, a technique that is not without complications [45].

Nutritional counseling is essential to prevent bezoar formation and recurrence, which has a 14% risk of recurrence [46]. Dietary counseling should include eating small meals, increasing fluid intake, chewing slowly and carefully, and avoiding high-fiber foods [40].

4.5 Anastomotic stricture (stenosis)

The stenosis at the gastrojejunostomy after RYGB occurs in up to 27% of patients [47]. The etiology is multifactorial, proposed mechanisms involved in the formation of stenosis include stomal ulcer, reflux, ischemia of the suture, or an inadequate surgical technique (size of circular staple anastomoses, or the initial size of the anastomosis) [48].

The gastroenterostomy constructed during an RYBG is made deliberately small to archive the restrictive effect of gastric bypass, with an optimal size between 10 and 12 mm [49]. It has been proposed that clinical manifestations occur when the anastomosis narrows to a diameter of <10 mm [50].

Symptoms include dysphagia, nausea, vomiting, and abdominal pain. Diagnosis is usually made by endoscopy, which also allows therapeutic treatment with endoscopic dilatation. To reduce the likelihood of recurrence, many authors advocate the use of through-the-scope (TTS) balloon catheters and dilatation to at least 15 mm [51]. If no improvement is achieved after four consecutive endoscopic dilations, surgical revision with reconstructive surgery may be indicated.

5. Conclusions

Bariatric surgery is growing in popularity worldwide as the prevalence of obesity increases. As the number of postoperative patients increases, so does the incidence of postoperative complications.

Postoperative bariatric surgery patients may seek urgent care at any emergency department, so in order to suspect and make a timely diagnosis, emergency physicians and general surgeons should have a basic knowledge of bariatric procedures and their potential complications.

Frequently, some of the complications of RYGB manifest as SBO. These include internal hernia, intussusception, bezoar formation, and anastomotic stenosis. The altered anatomy of the gastrointestinal tract secondary to the creation of a Roux-en-Y gastric bypass makes the symptoms very vague and different from classic bowel obstruction, making the diagnosis challenging. Misdiagnosis could result in inappropriate attempts at non-operative management with delays in surgical consultation and treatment with potentially fatal consequences.

Conflict of interest

The authors declare no conflict of interest.

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References

[1] World Obesity Federation. World Obesity Atlas 2023 [Internet]. 2023. Available from: https://data.worldobesity.org/publications/?cat=19 [Accessed: January 11, 2024]

[2] World Health Organization. Fact sheet: Obesity and Overweight [Internet]. 2015. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight [Accessed: January 4, 2024]

[3] Scully T, Ettela A, LeRoith D. Obesity, type 2 diabetes, and cancer risk. Frontiers in Oncology. 2021;**10**:615375. DOI: 10.3389/fonc.2020.615375

[4] Redinger RN. The pathophysiology of obesity and its clinical manifestations. Gastroenterology & Hepatology. 2007;**3**:856-863

[5] Pi-Sunyer FX. Comorbidities of overweight and obesity: Current evidence and research issues. Medicine & Science in Sports & Exercise. 1999;**31**:S602-S608. DOI: 10.1097/00005768-199911001-00019

[6] Fontaine KR, Redden DT, Wang C. Years of life lost due to obesity. Journal of the American Medical Association. 2003;**289**:187-193. DOI: 10.1001/jama.289.2.187

[7] International Federation for the Surgery of Obesity and Metabolic Disorders. Eighth Global Registry Report [Internet]. 2023. Available from: https://www.ifso.com/pdf/8th-ifso-registry-report-2023.pdf [Accessed: January 4, 2024]

[8] Brolin RE. Update: NIH consensus conference. Gastrointestinal surgery for severe obesity. Nutrition. 1996;**12**:403-404. DOI: 10.1016/s0899-9007(96)00154-2

[9] Eisenberg D, Shikora SA, Aarts E. 2022 American Society for Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of obesity and metabolic disorders (IFSO): Indications for metabolic and bariatric surgery. Surgery for Obesity and Related Diseases. 2022;**18**:1345-1356. DOI: 10.1016/j.soard.2022.08.013

[10] Billeter AT, Fischer L, Wekerle AL. Malabsorption as a therapeutic approach in bariatric surgery. Viszeralmedizin. 2014;**30**:198-204. DOI: 10.1159/000363480

[11] Switzer NJ, Karmali S, Gill RS. Revisional bariatric surgery. Surgical Clinics of North America. 2016;**96**:827-842. DOI: 10.1016/j.suc.2016.03.004

[12] Dimitriadis GK, Randeva MS, Miras AD. Potential hormone mechanisms of bariatric surgery. Current obesity reports. 2017;**6**:253-265. DOI: 10.1007/s13679-017-0276-5

[13] Wang W, Cheng Z, Wang Y. Role of bile acids in bariatric surgery. Frontiers in Physiology. 2019;**10**:374. DOI: 10.3389/fphys.2019.00374

[14] Ulker İ, Yildiran H. The effects of bariatric surgery on gut microbiota in patients with obesity: A review of the literature. Bioscience of microbiota, food and health. 2019;**38**:3-9. DOI: 10.12938/bmfh.18-018

[15] Izquierdo AG, Crujeiras AB. Obesity-related epigenetic changes after bariatric surgery. Frontiers in endocrinology. 2019;**10**:232. DOI: 10.3389/fendo.2019.00232

[16] Sakran N, Assalia A, Sternberg A. Smaller staple height for circular stapled gastrojejunostomy in laparoscopic gastric bypass: Early results in 1,074 morbidly obese patients. Obesity Surgery. 2011;**21**:238-243. DOI: 10.1007/s11695-010-0308-7

[17] Elms L, Moon RC, Varnadore S. Causes of small bowel obstruction after roux-en-Y gastric bypass: A review of 2,395 cases at a single institution. Surgical Endoscopy. 2014;**28**:1624-1628. DOI: 10.1007/s00464-013-3361-1

[18] Geubbels N, Lijftogt N, Fiocco M. Meta-analysis of internal herniation after gastric bypass surgery. British Journal of Surgery. 2015;**102**:451-460. DOI: 10.1002/bjs.9738

[19] Collard MK, Torcivia A, Genser L. Laparoscopic management of internal hernia after roux-en-Y-gastric bypass. Journal of Visceral Surgery. 2020;**157**:423-427. DOI: 10.1016/j.jviscsurg.2020.08.013

[20] Madan AK, Lo Menzo E, Dhawan N. Internal hernias and nonclosure of mesenteric defects during laparoscopic roux-en-Y gastric bypass. Obesity Surgery. 2008;**19**:549-552. DOI: 10.1007/s11695-008-9722-5

[21] Pokala B, Giannopoulos S, Stefanidis D. Prevention and management of internal hernias after bariatric surgery: An expert review. Mini-invasive Surgery. 2022;**6**:23. DOI: 10.20517/2574-1225.2021.136

[22] Tartamella F, Ziccarelli A, Cecchini S. Abdominal pain and internal hernias after roux-en-Y gastric bypass: Are we dealing with the tip of an iceberg? Acta bio-medica. 2019;**90**:251-258. DOI: 10.23750/abm.v90i2.7145

[23] Husain S, Ahmed AR, Johnson J. Small-bowel obstruction after laparoscopic roux-en-Y gastric bypass. Archives of Surgery. 2007;**142**:988-993. DOI: 10.1001/archsurg.142.10.988

[24] Nawas MA, Oor JE, Goense L. The diagnostic accuracy of abdominal computed tomography in diagnosing internal herniation following roux-en-Y gastric bypass surgery. Annals of Surgery. 2021;**275**:856-863. DOI: 10.1097/SLA.0000000000005247

[25] Bordonaro V, Brizi MG, Lanza F. Role of CT imaging in discriminating internal hernia from aspecific abdominal pain following roux-en-Y gastric bypass: A single high-volume Centre experience. Updates in Surgery. 2020;**72**:1115-1124. DOI: 10.1007/s13304-020-00767-w

[26] Lockhart ME, Tessler FN, Canon CL. Internal hernia after gastric bypass: Sensitivity and specificity of seven CT signs with surgical correlation and controls. American journal of roentgenology. 2007;**188**:745-750. DOI: 10.2214/AJR.06.0541

[27] Maier J, Herrasti Gallego A, Floyd AK. Compression of the superior mesenteric vein—A sign of acute internal herniation in patients with antecolic laparoscopic roux-en-Y gastric bypass. European Radiology. 2016;**27**:1733-1739. DOI: 10.1007/s00330-016-4526-9

[28] Kollmann L, Lock JF, Kollmann C. Surgical treatment of internal hernia after roux–en-Y gastric bypass — Impact of institutional standards and surgical approach. Langenbeck's Archives of Surgery. 2023;**408**:318. DOI: 10.1007/s00423-023-03049-2

[29] Zaigham H, Ekelund M, Regnér S. Long-term follow-up and risk of recurrence of internal herniation after roux-en-Y gastric bypass. Obesity Surgery. 2023;**33**:2311-2316. DOI: 10.1007/s11695-023-06653-9

[30] Harakeh A, Kallies KJ, Borgert AJ. Bowel obstruction rates in antecolic/antegastric versus retrocolic/retrogastric roux limb gastric bypass: A meta-analysis. Surgery for Obesity and Related Diseases. 2016;**12**:194-198. DOI: 10.1016/j.soard.2015.02.004

[31] Petrucciani N, Martini F, Kassir R. Internal hernia after one anastomosis gastric bypass (OAGB): Lessons learned from a retrospective series of 3368 consecutive patients undergoing OAGB with a biliopancreatic limb of 150 cm. Obesity Surgery. 2021;**31**:2537-2544. DOI: 10.1007/s11695-021-05269-1

[32] Oor JE, Goense L, Wiezer MJ. Incidence and treatment of intussusception following roux-en-Y gastric bypass: A systematic review and meta-analysis. Surgery for Obesity and Related Diseases. 2021;**17**:1017-1028. DOI: 10.1016/j.soard.2021.01.006

[33] Kumar A, Ogbonda S, Persaud P. Retrograde intussusception after roux-en-Y gastric bypass. Cureus. 2020;**12**:e8825. DOI: 10.7759/cureus.8825

[34] Simper SC, Erzinger JM, McKinlay RD. Retrograde (reverse) jejunal intussusception might not be such a rare problem: A single group's experience of 23 cases. Surgery for Obesity and Related Diseases. 2008;**4**:77-83. DOI: 10.1016/j.soard.2007.12.004

[35] Singla S, Guenthart BA, May L. Intussusception after laparoscopic gastric bypass surgery: An Underrecognized complication. Minimally Invasive Surgery. 2012;**2012**:1-8. DOI: 10.1155/2012/464853

[36] Daellenbach L, Suter M. Jejunojejunal Intussusception After Roux-en-Y Gastric Bypass: A Review. 2011;**21**:253-263. DOI: 10.1007/s11695-010-0298-5

[37] Iwamuro M, Okada H, Matsueda K. Review of the diagnosis and management of gastrointestinal bezoars. World Journal of Gastrointestinal Endoscopy. 2015;**7**:336-345. DOI: 10.4253/wjge.v7.i4.336

[38] Roy M, Fendrich I, Li J. Treatment option in patient presenting with small bowel obstruction from Phytobezoar at the Jejunojejunal anastomosis after roux-en-Y gastric bypass. Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2012;**22**:e243-e245. DOI: 10.1097/SLE.0b013e31825d6c07

[39] Ertugrul I, Tardum Tardu A, Tolan K. Gastric bezoar after roux-en-Y gastric bypass for morbid obesity: A case report. International Journal of Surgery. 2016;**23**:112-115. DOI: 10.1016/j.ijscr.2016.04.008

[40] Ben-Porat T, Sherf Dagan S, Goldenshluger A. Gastrointestinal phytobezoar following bariatric surgery: Systematic review. Surgery for Obesity and Related Diseases. 2016;**12**:1747-1754. DOI: 10.1016/j.soard.2016.09.003

[41] Dikicier E, Altintoprak F, Ozkan OV. Intestinal obstruction due to phytobezoars: An update. World Journal of Clinical Cases. 2015;**3**:721-726. DOI: 10.12998/wjcc.v3.i8.721

[42] Rodríguez J, Kobus V, Téllez I. Obstrucción intestinal por fitobezoar en una paciente con bypass gástrico laparoscópico en Y de Roux: Reporte de un caso. Revista de cirugía. 2019;**71**:330-334. DOI: 10.4067/S2452-45492019000400330

[43] Paschos KA, Chatzigeorgiadis A. Pathophysiological and clinical aspects of the diagnosis and treatment of bezoars. Annals of Gastroenterology. 2019;**32**:224-232. DOI: 10.20524/aog.2019.0370

[44] Dwivedi AJ, Chahin F, Agrawal S. Gastric phytobezoar: Treatment using meat tenderizer. Digestive Diseases and Sciences. 2001;**46**:1013-1015. DOI: 10.1023/a:1010701809950

[45] Yakan S, Sirinocak A, Telciler KE. A rare cause of acute abdomen: Small bowel obstruction due to phytobezoar. Turkish journal of trauma & emergency surgery. 2010;**16**:459-463

[46] Kanwar P, Cheung D, Verma S. Bezoars: A rare, late complication of roux-en-Y gastric bypass and a novel endoscopic technique for treatment. American Journal of Gastroenterology. 2016;**111**:S1098-S1099

[47] Nguyen NT, Stevens CM, Wolfe BM. Incidence and outcome of anastomotic stricture after laparoscopic gastric bypass. Journal of Gastrointestinal Surgery. 2003;**7**:997-1003. DOI: 10.1016/j.gassur.2003.09.016

[48] Espinel J, Pinedo E. Stenosis in gastric bypass: Endoscopic management. World Journal of Gastrointestinal Endoscopy. 2012;**4**:290-295. DOI: 10.4253/wjge.v4.i7.290

[49] Schwartz ML, Drew RL, Roiger RW. Stenosis of the Gastroenterostomy after laparoscopic gastric bypass. Obesity Surgery. 2004;**14**:484-491. DOI: 10.1381/096089204323013460

[50] Ukleja A, Afonso BB, Pimentel R. Outcome of endoscopic balloon dilation of strictures after laparoscopic gastric bypass. Surgical Endoscopy. 2008;**22**:1746-1750. DOI: 10.1007/s00464-008-9788-0

[51] Huang CS. The role of the endoscopist in a multidisciplinary obesity center. Gastrointestinal Endoscopy. 2009;**70**:763-767. DOI: 10.1016/j.gie.2009.01.009