

The ABC System: A Simplified Classification System for Small Bowel Obstruction After Laparoscopic Roux-en-Y Gastric Bypass

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Abstract Small bowel obstruction (SBO) after bariatric surgery is well documented. Although infrequent, it can be associated with considerable morbidity and mortality. The laparoscopic approach to Roux-en-Y gastric bypass (LRYGB) has gained widespread popularity for the treatment of morbid obesity since its first description in 1994. One of the theoretical advantages of a minimally invasive technique is reduced intraabdominal adhesions and, consequently, diminution in the incidence of SBO. However, the laparoscopic approach demonstrates a similar rate of obstruction to the open procedure. In this review, an electronic literature search was undertaken of Medline, Embase, and Cochrane databases for the period January 1990 to October 2006 on the history, presentation, clinical evaluation, preoperative diagnostic techniques, and management of SBO after LRYGB compared to the open approach.

Keywords Complications · Laparoscopy · Morbid obesity · Morbidity · Mortality · Roux-en-Y gastric bypass · Small bowel obstruction

Introduction

Morbid obesity has reached epidemic proportions in the US. Thirty percent of adults are obese and 15% are morbidly obese [1]. This problem is not only confined to

the US, but is a major health problem worldwide. Bariatric surgery is the only successful treatment option for maintained long-term weight loss in the morbidly obese, and the Roux-en-Y gastric bypass (RYGB) is the most common procedure performed [1–3]. The laparoscopic approach to the RYGB has been increasing in popularity with demonstrated advantages over the traditional open technique in terms of fewer wound complications, better cosmesis, less postoperative pain, shorter length of hospital stay, faster recovery, and reduced incidence of incisional hernias [4–7]. However, complications including gastric outlet obstruction, anastomotic leaks, ulcers, and small bowel obstruction (SBO) are similar between the two techniques [8–11]. Some studies report a higher incidence of SBO after laparoscopic Roux-en-Y Gastric Bypass (LRYGB) when compared to the open approach [3, 12, 13]. Also, there are notable differences in the etiology, presentation, and management of SBO after LRYGB [3, 9, 11, 14–16].

Therefore, an electronic literature search of the Medline, Embase, and Cochrane databases was undertaken for the period January 1990 to October 2006 on the history, presentation, clinical evaluation, preoperative diagnostic techniques, and management of SBO after LRYGB compared to the open approach. Simplified classification systems were then devised to describe SBO on the basis of the anatomic site of obstruction and timing of onset of symptoms after LRYGB.

Various Surgical Techniques

The first open RYGB for weight loss was performed by Mason and Ito in 1967, and it is now regarded as the gold standard procedure by most bariatric surgeons [2, 17, 18].

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Wittgrove et al. introduced the laparoscopic approach in 1994 confirming its safety and feasibility as an alternative technique [19]. The RYGB is performed by creating a small volume gastric pouch and a Roux-en-Y gastroenterostomy [20, 21]. A small 15–30 ml proximal gastric pouch based on the lesser curvature is fashioned with exclusion of the fundus and the remainder of the stomach. The jejunum is transected 45–50 cm distal to the ligament of Treitz creating the biliopancreatic limb. The transected distal jejunal loop or alimentary limb is anastomosed to the gastric pouch to create a narrow gastrojejunal anastomoses (GJA) or stoma. The biliopancreatic limb is then anastomosed to the

Table 1 Etiology of small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Etiology of small bowel obstruction	
Alimentary limb	
Acute	Internal hernia through Peterson's space Jejunojejunostomy stenosis Intussusception of roux limb Angulation of roux limb at jejunojejunostomy Torsion of roux limb Intraluminal hematoma Intramural hematoma Anastomotic leak Tight mesocolic closure Mesocolic hematoma Angulation of roux limb at fixation to mesocolic defect
Chronic	Internal hernia through Peterson's space Anastomotic stricture Mesocolic fibrotic constriction of roux limb
Biliopancreatic limb	
Acute	Jejunojejunostomy stenosis Intraluminal hematoma Intramural hematoma Mesenteric hematoma Intussusception of jejunojejunostomy Kinking of jejunojejunostomy Anastomotic leak Volvulus
Chronic	Internal hernia Anastomotic stricture
Common channel	
Acute	Anastomotic leak Jejunojejunostomy stenosis Intraluminal hematoma Intramural hematoma Mesenteric hematoma Incarcerated abdominal wall hernia: Trocar site/previous surgical incision Whole gut volvulus around roux limb
Chronic	Internal hernia Adhesions

Table 2 Diagnosis of small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Diagnosis of small bowel obstruction	
Symptoms	Intermittent/persistent/recurrent Acute/chronic
Examination	Tachycardia Dehydration Abdominal distention Abdominal tenderness Incarcerated ventral hernia Sepsis Peritonitis
Blood tests	White cell count Liver function tests Alkaline phosphatase Amylase Lipase
Imaging	Plain radiograph Upper gastrointestinal contrast study Abdominal computed tomography scan

alimentary limb ≥ 100 cm below the gastrojejunostomy to create a common channel. The majority of the stomach, duodenum, and proximal jejunum are excluded or 'bypassed'. Weight loss occurs because of the reduction in gastric volume with restricted intake and early satiety, the dumping syndrome precipitated by ingestion of simple sugars and fats, and a degree of malabsorption [22, 23].

The techniques of open and LRYGB are not standardized, and variations exist between centers. The GJA is traditionally created in a retrocolic retrogastric fashion in open RYGB. In the minimally invasive era, several techniques are used, including antecolic antegastric, retrocolic antegastric, or retrocolic retrogastric approaches [4, 8, 11, 15, 24]. It is technically easier to bring the alimentary limb anterior to the transverse colon rather than creating a

Table 3 Localization of site of small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Localization of site of small bowel obstruction	
Alimentary limb	
Dilated alimentary limb	
Biliopancreatic limb	
Dilated duodenum, biliopancreatic limb, and gastric remnant	
Elevated liver function tests	
Elevated amylase	
Common channel	
Dilated biliopancreatic limb, alimentary limb, and gastric remnant	
Elevated liver function tests	
Elevated amylase	

Table 4 Published classification systems for small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Published classification systems for small bowel obstruction
Presentation
Acute
Chronic
Onset after surgery [7, 12, 15]
Early
Late
Extent [11]
Complete small bowel obstruction
Partial small bowel obstruction
Anatomy [11]
Type I: roux limb
Type II: biliopancreatic limb
Type III: common channel

retrocolic tunnel, which can be time consuming and inherently hazardous with bleeding from the often bulky mesocolon in the morbidly obese patient [4]. Some surgeons continue to routinely use a retrocolic retrogastric approach to reduce tension on the GJA, particularly in superobese patients with a bulky greater omentum or in those with a foreshortened small intestinal mesentery [25]. The retrocolic defect can be closed in an interrupted fashion, a continuous fashion, or not at all [8, 14, 26]. Other mesenteric defects including the jejunojejunal and Petersen’s space (retro-Roux loop) can be closed or left open [4, 11]. Absorbable or nonabsorbable suture can be used to close the mesenteric defects [11, 14]. The length of the alimentary limb is also not standardized and varies from 75 to 200 cm, according to individual patient’s body mass index and surgeon preference [4, 24]. The jejunal mesentery can be divided to lengthen the roux limb or not [4, 8].

An antikink suture, otherwise known as a Brolin stitch, can be routinely or selectively inserted after the completion of the jejunojejunostomy [8, 27]. The roux limb can be fixed or not when a retrocolic approach is used [11, 26]. The greater omentum can be divided to reduce tension on the GJA, not divided, or a window can be created in it for the roux limb [15]. Circular staplers, linear staplers, handsewn techniques, or a combination of these can be used to create and close the gastrojejunal and jejunojejunal anastomoses [4, 6, 28]. Finally, trocar sites may or may not be closed [4].

Clinical Evaluation

There are many causes of SBO after LRYGB (Table 1). The most common etiologies include iatrogenic causes because of narrow anastomoses, overzealous closure of mesenteric defects, mesenteric or intramural hematoma, anastomotic leak, incarcerated ventral hernias, internal hernias, and adhesions. Depending on the cause, patients develop symptoms in the immediate postoperative period, in the weeks after surgery, months, or even years later. Obstruction can involve the alimentary limb, biliopancreatic limb, common channel, or more distally if adhesive in nature. Because of the differences in surgical technique, the incidence of SBO varies from 0.4% to 7.45% [3]. With the adoption of the laparoscopic approach, there has been a reduction in postoperative SBO secondary to adhesions and incisional hernias. However, a higher incidence of SBO because of internal hernias is seen compared to the open procedure [12, 13]. Early series of laparoscopic bypass reported an incidence of SBO of 1.5–3.5% with most attributed to internal hernias but with a short follow-up period of less than 2 years [7, 29]. Internal herniation can

Table 5 Current classification systems for small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Series	Year	No. of cases	Incidence of small bowel obstruction, <i>n</i> (%)	Extent of small bowel obstruction	Obstructed anatomic portion of small bowel	Onset of small bowel obstruction
Cho et al. [9]	2006	1,400	21 (1.5)	Complete Partial	Type I: alimentary limb Type II: common channel Type III: biliopancreatic limb	Early: <4 weeks Late: >4 weeks
Nguyen et al. [24]	2004	225	9 (4)	NA	NA	Early: ≤46 days Late: >46 days
Hwang et al. [8]	2004	1,715	51 (3)	NA	NA	Early: <3 weeks Late: >3 weeks
Felsher et al. [14]	2003	115	6 (5.2)	NA	NA	Early: <3 months Late: >3 months

NA: not applicable

Table 6 Simplified classification system for small bowel obstruction based on site of anatomic obstruction after laparoscopic Roux-en-Y gastric bypass

Type	Site of anatomic obstruction
A	Alimentary limb obstruction
B	Biliopancreatic limb obstruction
C	Common channel obstruction

occur at the jejunojejunostomy, Petersen's space, or the transverse mesocolonic defect after a retrocolic approach. The incidence of internal hernias is higher after the retrocolic retrogastric approach and has been significantly reduced by adoption of the antecolic antegastric approach in reported series from 4.5% to 0.43% [15].

Patients can present acutely with the classical symptoms and signs of SBO or chronically with vague symptoms. Late SBO typically presents with intermittent, recurrent cramping periumbilical pain, which may be associated with intermittent nausea and vomiting. Not uncommonly, patients present to their local emergency room or primary care physician with recurrent vague symptoms and often their complaints are explained by failure to comply with diet, gastroesophageal reflux disease, postprandial pain, or marginal ulceration. Diagnosis is based on symptoms, clinical examination, and investigative tools including blood tests, plain abdominal radiographs, upper gastrointestinal contrast studies, and abdominal computed tomography scans (Tables 2 and 3). A methodical approach facilitates the identification of the site of obstruction in the majority of patients before

surgery. Although symptoms are often similar, the presence of gastroesophageal reflux and significant vomiting is suggestive of an obstruction to the alimentary limb or common channel. Distention of the biliopancreatic limb and gastric remnant with elevated liver function tests and hyperamylasemia is suggestive of obstruction of the biliopancreatic limb or common channel (Table 3). Treatment is directed by the clinical condition of the patient and involves nasogastric decompression with early surgical intervention in the form of diagnostic laparoscopy.

Classification Systems

Numerous descriptive terms have been employed in an attempt to classify SBO after LRYGB in reported series based on presentation, onset after surgery, extent of obstruction, or anatomical site (Table 4) [8, 9, 14, 24]. The most commonly used method has been onset of symptoms in relation to duration after surgery in terms of early or late presentation [8, 9, 14, 24]. However, published classification systems of early presentation of SBO range from <3 weeks to <3 months, and similarly late presentation range from >3 weeks to >3 months (Table 5). It is clear that a simplified classification system is required. This would facilitate a uniform system of interpretation, understanding, and diagnosis of SBO after RYGB in the emergency room and facilitate more effective communication between nonbariatric surgeons in the general community with specialists in bariatric centers. An easily applicable system of classification would also enable

Table 7 Onset of small bowel obstruction after laparoscopic Roux-en-Y gastric bypass

Series	Year	No. of cases	Incidence of SBO, <i>n</i> (%)	Time to SBO (days), mean (Range)	Onset of SBO according to previous classification (%)	Type of roux limb
Cho et al. [9]	2006	1,400	21 (1.5)	234.5 (7–1,148)	Early <4 weeks, <i>n</i> =10 (48) Late >4 weeks, <i>n</i> =11 (52)	Antecolic antegastric
Nguyen et al. [24]	2004	225	9 (4)	80 (4–224)	Early ≤46 days, <i>n</i> =6 (67) Late >46 days, <i>n</i> =3 (33)	Retrocolic retrogastric
Hwang et al. [8]	2004	1,715	55 (3)	NR	Early <3 weeks, <i>n</i> =24 (44) Late >3 weeks, <i>n</i> =31 (56)	Retrocolic, <i>n</i> =405 Antecolic, <i>n</i> =1,310
Lauter et al. [30]	2004	NR	(9)	157 (0–1,414)	NA	Retrocolic, <i>n</i> =8 Antecolic, <i>n</i> =1
Felsher et al. [14]	2003	115	6 (5.2)	23 (1–42)	Early: <3 months, <i>n</i> =6 (100) Late: >3 months, <i>n</i> =0	Retrocolic
Champion et al. [15]	2003	711	13 (1.8)	21 (5–1,095)	NA	Antecolic, <i>n</i> =246 Retrocolic, <i>n</i> =465

SBO: small bowel obstruction, NR: not reported, NA: not applicable

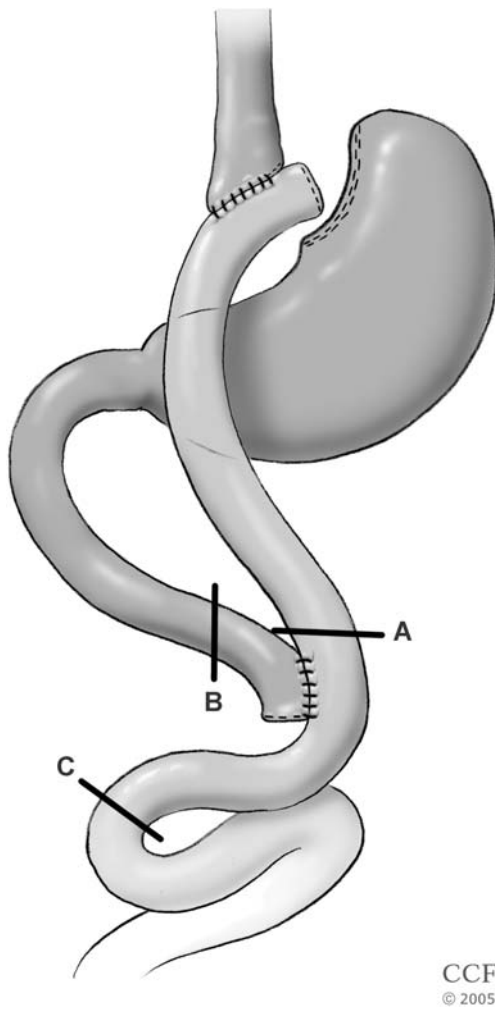
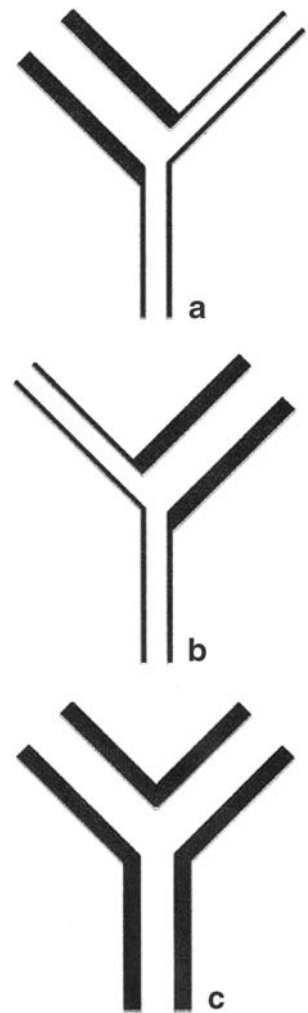


Fig. 1 The ABC system of classification of small bowel obstruction based on site of anatomic obstruction after laparoscopic Roux-en-Y gastric bypass. *A* Alimentary limb, *B* biliopancreatic limb, *C* Common channel. With permission from the Journal of the American College of Surgeons and Cleveland Clinic, Cleveland, OH, USA

uniform reporting of data and would allow comparison of postoperative morbidity among bariatric centers. This classification system would also permit a clearer understanding of the nature of the SBO after RYGB with more effective communication between bariatric specialists and accurate reporting of data with increased clarity of data analysis in the published literature.

Our proposed classification system is based on the anatomical site of obstruction, and onset of symptoms from the date of surgery (Tables 5, 6, and 7). With regard to the anatomical site of obstruction, we propose the following classification: type A, alimentary limb obstruction; type B, biliopancreatic limb obstruction; and type C, common channel obstruction (Table 5; Figs. 1 and 2). The time to

Fig. 2 Schematic representation of the ABC system of classification of small bowel obstruction after laparoscopic Roux-en-Y gastric bypass. **a** Alimentary limb, **b** biliopancreatic limb, **c** common channel



SBO varies from 0 to 1,414 days after LRYGB in reported series with 44–48% occurring within the first month (Table 7) [8, 9, 14, 15, 24, 30]. In terms of the timing of onset of SBO after surgery, we propose the following additional classification system: acute early SBO, ≤ 30 days after LRYGB; acute late SBO, ≥ 30 days and < 12 months after LRYGB; and chronic SBO, ≥ 12 months after LRYGB (Table 8).

Table 8 Simplified classification system for small bowel obstruction based on timing of onset after laparoscopic Roux-en-Y gastric bypass

Type	Time of onset of obstruction
Acute early	≤ 30 days
Acute late	> 30 days, < 12 months
Chronic	≥ 12 months

Summary

Early diagnosis and treatment of SBO after LRYGB is crucial to avoid the development of catastrophic complications including anastomotic dehiscence, staple line disruption, small bowel ischemia, infarction, and gangrene. It is important to recognize that the most common cause of SBO after LRYGB is internal herniation, which will result in intestinal ischemia, perforation with peritonitis, sepsis, and death if not managed in a timely and appropriate fashion. Our proposed simplified classification system of SBO after LRYGB, based on the anatomical location of the obstruction and onset after surgery, will facilitate a better understanding of the underlying pathology and allow more effective communication between the nonbariatric and bariatric surgical community to ultimately improve patient management and outcome.

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