

## A complication of Roux-en-Y gastric bypass: intestinal obstruction

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### Abstract

**Background** Intestinal obstruction is a significant and increasingly recognized complication after laparoscopic and open gastric bypass.

**Materials and methods** The medical records of 3,463 patients who had gastric bypass during the study period from July 1997 to December 2004 at a single bariatric center were evaluated. 1,120 one hundred and twenty patients had retrocolic, retrogastric Roux limb placement and 2,343 patients had antecolic, antegastric.

**Results** 40 patients had 44 intestinal obstructions (1.27%). The onset ranged from 1 day to 7 years postoperatively (mean 16.9 months). Internal hernia at the transverse mesocolon defect was the most common cause. 36 (3.2%) obstructions were observed in retrocolic, retrogastric vs. 8 (0.3%) in antecolic, antegastric approach. Internal hernia repair at mesocolinic effect ( $n = 11$ ), jejunojejunostomy mesenteric defect repair ( $n = 7$ ), lysis of adhesions ( $n = 16$ ) were the most common procedures. A total of 70.5% were done laparoscopically.

**Conclusions** A high index of suspicion is needed to diagnose bowel obstruction after gastric bypass. Radiological imaging of the abdomen has significant limitations. Surgical exploration should be performed without delay. Diagnostic laparoscopy is a safe and effective therapy. We recommend closing all mesenteric defects to prevent

internal hernias. The antecolic, antegastric technique reduces the incidence of internal hernias.

**Keywords** Obesity · Bariatric surgery · Small bowel obstruction · Internal hernia

Intestinal obstruction is a significant complication of Roux-en-Y gastric bypass (RYGB) surgery. This complication is recognized more frequently as the number of patients undergoing bariatric surgery increases. All bariatric surgeons, general surgeons, and physicians involved with postoperative management of the bariatric surgery patient should be familiar with this potentially life-threatening complication. We present our experience with intestinal obstruction in a large population of gastric bypass patients together with a review of the etiology, diagnosis, management, and prevention of this complication of bariatric surgery.

### Materials and methods

Patients with intestinal obstruction after gastric bypass surgery were evaluated during the study period (July 1997 to December 2004) at the University of Pittsburgh under the direction of the senior author (P.R.S.). The jejunojejunostomy was created using a 60-mm Endo-GIA stapler (Auto Suture, Norwalk, CT, USA) blue load (3.5 mm) for the initial 100 cases and white load (2.5 mm) for the remaining cases. The gastrojejunal anastomosis was created with a 21-mm EEA stapler (Endopath, Ethicon Endosurgery, Cincinnati, OH, USA) for the first 150 cases. Subsequently, the gastrojejunal anastomosis was created in

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**Table 1** Demographics of 40 patients with postoperative intestinal obstruction after Roux-en-Y gastric bypass surgery performed for 3,463 patients

Age (years): mean (range)	43 (29–57)
Sex: M/F (%)	2/38 (5/95)
Initial procedure: <i>n</i> (%)	
LRYGB	37 (92.5)
ORYGB	3 (7.5)
Additional surgical procedures: <i>n</i>	
Umbilical hernia repair	3
Lysis of adhesions	2
Cholecystectomy	2
Paraesophageal hernia repair	1
Patients with prior abdominal surgery: <i>n</i> (%)	6 (15)
LRYGB, laparoscopic Roux-en-Y gastric bypass; ORYGB, open Roux-en-Y gastric bypass	

**Table 2** Imaging studies

Imaging	<i>n</i> (%)
AXR + CT abdomen	13 (29.5)
AXR + UGI	11 (25)
AXR	11 (25)
UGI	3 (6.8)
CT	2 (4.5)
AXR + CT + EGD	1 (2.3)
AXR + CT + UGI	1 (2.3)
No imaging	2 (2.3)

AXR, abdominal x-ray; CT, computed tomography; UGI, upper gastrointestinal tract; EGD, upper endoscopy; UGI, upper gastrointestinal series

**Table 3** Timing and cause of 44 intestinal obstructions in 40 patients

Months until obstruction: <i>n</i> (range)	16.9 (1–88.2)
Internal hernia: <i>n</i> (%)	18 (40.9)
Adhesions: <i>n</i> (%)	15 (34.1)
Abdominal wall hernia: <i>n</i> (%)	5 (11.4)
Mechanical obstruction at JJ: <i>n</i> (%)	4 (9.1)
Intraluminal blood clot: <i>n</i> (%)	1 (2.3)
Obstruction of colon due to Roux limb mesentery: <i>n</i> (%)	1 (2.3)
Recurrent hernia: <i>n</i> (%)	4 (9.1)

JJ, jejunojunostomy

an end-to-side fashion using the Endo-GIA stapler 45 mm blue load (3.5 mm). The gastroenterotomy was closed in two layers using the Endostitch suturing device (Auto Suture).

Initially, we used a retrocolic and retrogastric Roux limb placement (first 1,120 cases). In April 2002, we changed to an antecolic, antegastric approach (remaining 2,343 cases).

## Results

During the study period, 3,463 gastric bypass procedures were performed. A total of 40 patients had 44 intestinal obstructions, for an incidence of 1.27% (Table 1). Four of the 40 patients had recurrent obstruction. The patients ranged in age from 29 to 57 years (mean, 42.7 years). All the patients except for two were women.

The onset of intestinal obstruction ranged from postoperative day 1 to 7 years after surgery (mean; 16.9 months). Three patients underwent open gastric bypass, and the remainder had the laparoscopic approach. The most common presentation was abdominal pain ( $n = 41$ ), followed by nausea and vomiting ( $n = 21$ ). A total of 14 obstructions presented with abdominal distension. Abdominal x-ray was the most common investigation ( $n = 37$ ), followed by computed tomography (CT) scan ( $n = 16$ ) and upper gastrointestinal (GI) series ( $n = 14$ ) (Table 2).

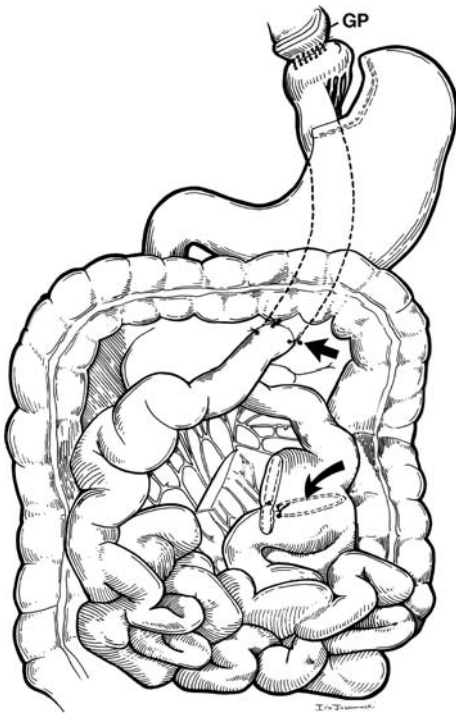
Internal herniation at the transverse mesocolon defect or the mesenteric defect at the jejunojunostomy was the most common cause ( $n = 18$ ), followed by adhesions ( $n = 15$ ) (Table 3; Fig. 1). A total of 53 procedures were performed for 44 obstructions. In one case, no intervention was performed because the obstruction at the jejunojunostomy was related to anastomotic edema. Internal hernia repair ( $n = 18$ ) at the mesocolon defect ( $n = 11$ ) and mesenteric defect at the jejunojunostomy ( $n = 7$ ) were the most common procedures needed to correct the obstruction, followed by lysis of adhesions ( $n = 16$ ) (Table 4). The vast majority of the cases (70.5%) were managed laparoscopically.

In the initial 1,120 retrocolic, retrogastric cases, 36 obstructions (3.2%) were observed. The remaining 2,343 patients had antegastric, antecolic gastric bypass surgery, and obstruction developed in 8 of these patients (0.3%). No mesocolon defect hernias occurred after conversion from the retrocolic retrogastric technique to the antecolic antegastric technique.

## Discussion

### Etiology

Postoperative small bowel obstruction usually is seen in the later postoperative course, more than 1 month after surgery. It can, however, appear even immediately or many years after surgery. The timing of bowel obstruction often is related to its etiology. Small bowel obstruction after gastric bypass surgery can be caused by adhesions, internal hernia, hemorrhagic bezoar, incarcerated ventral hernia, or intussusception.



**Fig. 1** Retrocolic, retrogastric Roux-en-Y gastric bypass surgery. Superior arrow shows site of the transmesocolon defect leading to herniation. Inferior arrow shows site of the mesenteric defect at the jejunojejunostomy that may lead to herniation. The Petersen defect is between the mesentery of the Roux limb and the mesocolon, which also is a potential hernia site. The authors recommend suture closure of all three potential hernia sites. From Blachar A, Federle MP, Pealer KM, Ikramuddin S, Schauer PR (2002) Gastrointestinal complications of laparoscopic Roux-en-Y gastric bypass surgery: clinical and imaging findings. *Radiology* 22:625–632

Small bowel obstruction resulting from internal hernia has been noted to occur at a rate of 2.6% to 5% after laparoscopic RYGB (LRYGB) in many series [1–3]. Bowel obstruction secondary to internal hernias usually presents in the later postoperative period. Three potential spaces of internal herniation are the Petersen hernia defect (between the Roux-limb mesentery and the mesocolon), the jejunojejunostomy mesenteric defect, and the transverse mesocolon defect. Twisting of the small bowel in any of these defects can result in its obstruction and possible ischemia. A predisposing factor for the development of internal hernia in these patients may be the rapid massive weight reduction, which results in decreased intraperitoneal fat, which may enlarge the mesenteric defect.

Early small bowel obstructions (in less than 1 month) usually result from technical problems with the Roux limb. Causes include complete blockage or partial narrowing of the gastrojejuno or jejunojejuno anastomosis, acute angulation of the Roux limb, and narrowing of the Roux limb at the level of the transverse mesocolon. The latter obstruction also is seen as a late complication due to scarring at the transverse mesocolon defect.

Technical errors are related to the learning curve of the laparoscopic approach and usually occur in the first 100 cases [4]. The introduction of the laparoscopic technique for gastric bypass surgery increased the frequency of small bowel obstruction compared with open surgery [5]. The incidence of bowel obstruction after laparoscopic surgery ranges from 1.8% to 7.3%, compared with 1.3% to 4% after open gastric bypass surgery [1, 6]. Hernia rates for the laparoscopic approach decrease with experience. The open operation may lead to the formation of upper abdominal adhesions that fix the bowel and prevent internal hernias through the mesenteric openings created during the initial operation.

Bowel obstruction caused by jejunojejunal intussusception after gastric bypass is rarely recognized [7, 8]. It usually occurs after significant weight loss, and its cause seems to be multifactorial, involving a lead point (suture lines, adhesions, and lymphoid hyperplasia), motility disturbances, and aberrant intestinal pacemakers and motility disturbances [9, 10].

Staple line bleeding can potentially cause proximal small bowel obstruction at the jejunojejunoanastomosis after gastric bypass. It usually presents with tachycardia and abdominal pain. Gastrografin study may show partial bowel obstruction. Anastomotic revision may be necessary in selected cases [11].

Increased occurrence of small bowel obstruction has been documented in women of childbearing age [12]. Obstruction, incarceration, and strangulation of bowel from an internal hernia can occur in the pregnant patient, leading to significant morbidity and mortality for the patient, for an unborn fetus, or for both. Maternal death after midgut volvulus, perforation, and septic shock have been described in the literature [13, 14].

#### Prevention

Specific measures should be instituted to prevent bowel obstruction after gastric bypass surgery. Routine closure of the mesenteric defect at the jejunojejunostomy, transverse mesocolon mesenteric defect, and the Petersen defect is recommended [15]. Brolin et al. [16] advocated the placement of an “antiobstruction suture” at the jejunojejunostomy to prevent bowel obstruction at the afferent limb. We recommend placement of a suture on the proximal Roux limb that fixes it to the remnant stomach to prevent angulation of the Roux limb’s proximal part (antecolic, antegastric technique).

Use of an appropriate closure technique for the mesenteric defect plays a critical role in the prevention of bowel obstruction at the jejunojejunoanastomosis. Interrupted or continuous sutures or the double stapling technique are

**Table 4** Surgical procedures performed

Laparotomy: <i>n</i> (%)	13 (29.5)
Laparoscopy: <i>n</i> (%)	31 (70.5)
Procedures: <i>n</i>	
Lysis of adhesions	16
Repair of transverse mesocolon defect	11
Repair of small bowel mesenteric defect	7
Repair of ventral hernia	3
Removal of suture at JJ causing kink	2
Reduction of internal hernia between staple line and suture(crotch stitch) at JJ and removal of suture	1
Small bowel resection	2
Revision of JJ	2
Repair of port-site hernia	1
Division of small bowel mesentery	1
Repair of inguinal hernia	1
EGD and evacuation of blood clot	1
Repair of Petersen defect	1
Repair of gastric remnant perforation	1
Cholecystectomy	1
Appendectomy	1
Gastrostomy tube insertion	1
No intervention	1

EGD, upper endoscopy; JJ, jejunojejunostomy

used. The potential for obstruction due to luminal narrowing is increased when too much tissue is taken into the stapler [17].

The position of the Roux limb (retrocolic vs antecolic) influences the incidence of small bowel obstruction. The antecolic technique decreases the incidence of small bowel obstruction because it eliminates the mesocolonic defect as a site of potential obstruction [18]. However, the antecolic technique does not entirely prevent internal herniation. If the small bowel mesentery is under tension, this can obstruct the transverse colon in a bowstring fashion. Also, an unclosed space between the transverse colon and the mesentery of the Roux limb (i.e., the Petersen space) can be a potential internal herniation site.

Port sites larger than 10 mm should be closed routinely to prevent port-site herniation. A full-thickness closure can be facilitated by using port-site closing devices [19].

## Diagnosis

A high index of suspicion is needed for the diagnosis of bowel obstruction. Symptoms of internal herniation usually are vague. Nausea, emesis, and postprandial abdominal pain (usually in the left upper quadrant) are common complaints. Because of change in the GI anatomy, patients

may not present with typical signs and symptoms of bowel obstruction. Upper GI series, CT scan, and diagnostic laparoscopy should be used liberally in the diagnosis.

A diagnosis of complete or partial small bowel obstruction can be made by performing an upper GI. However, the specific cause may not be evident. Findings that favor a diagnosis of internal hernia include a cluster of dilated bowel segments in the left upper or middle abdomen, which remain relatively fixed in this high position on views obtained with the patient in an erect position [20].

After Roux-en-Y gastric bypass surgery, CT scans can be helpful in depicting signs of an internal hernia. In transmesenteric internal hernia, when the Roux limb is herniated, CT scanning shows a cluster of dilated bowel segments in the expected position of the Roux-en-Y loop [20]. Other CT findings suggestive of an internal hernia include small bowel mesentery traversing the transverse colon mesentery and location of the jejunojejunostomy superior to the transverse colon. In addition, crowding, stretching, and engorgement of the main mesenteric trunk to the right and signs of small bowel obstruction may be seen [21]. A swirled appearance of mesenteric fat or vessels was found to be the best single predictor of hernia, with a sensitivity of approximately 80% and a specificity of 90% [22].

However, CT imaging of the abdomen has limitations for the diagnosis of internal hernia. Higa et al. [23] reported negative CT scanning for 20% of patients with internal hernias. In other series, CT scanning was diagnostic for 64% of patients with internal hernia [24].

Anastomotic stricture can be diagnosed with upper GI series, as well as with endoscopy [25]. Endoscopy also can be therapeutic in some cases. Strictures can be treated successfully with endoscopic balloon dilation [26].

## Operative management of bowel obstruction

Surgical exploration of patients with suspected internal hernia should be performed without delay. A reluctant operative decision can result in the development of a closed loop obstruction, a potentially devastating problem. Despite normal CT scans, a diagnostic laparoscopy is recommended if the clinical symptoms suggest an internal hernia. The entire small bowel and all the potential hernia defects should be carefully evaluated. If hernias are found, the repair involves reducing the hernia and closing defects. Remaining defects should be closed if they have not already been closed.

Laparoscopic lysis of adhesions should be performed if a strangulated band causes obstruction. A dilated gastric remnant may require decompression using a long needle or placement of a gastrostomy tube. A dilated Roux limb



proximal to the obstruction site rarely requires decompression of the small bowel distal to the obstruction site.

Narrowing of the jejunojejunostomy due to incorrect stapling of the jejunojejunostomy may require creation of a new enteroenterostomy proximal to the obstruction site. Angulation of the Roux limb at the jejunojejunostomy requires repositioning of the Roux limb and placement of an antiobstruction suture.

The laparoscopic approach for managing bowel obstruction is based on the extent of bowel dilation and the site of bowel obstruction. Distal obstruction with concomitant severe bowel dilation often prohibits safe laparoscopic entry and may require laparotomy.

### Conservative treatment

Roux limb obstruction resulting from edema of the jejunojejunostomy or gastrojejunostomy usually requires conservative treatment consisting of no nourishment by mouth and the administration of intravenous fluids. Total parenteral nutrition is rarely needed because this problem usually resolves within a few days. Obstruction at the transverse mesocolon typically is managed conservatively.

### Conclusion

Bowel obstruction is a relatively frequent complication after laparoscopic gastric bypass surgery. Closure of all mesenteric defects is highly recommended to prevent internal hernias. The antegastric, antecolic approach reduces the incidence of internal hernias at the transmesocolon defect. Early diagnosis and surgical exploration in suspected cases is the key to a successful outcome.

### References

1. Champion JK, Williams M (2003) Small bowel obstruction and internal hernias after laparoscopic Roux-en-Y gastric bypass. *Obes Surg* 13:596–600
2. Felsher J, Brodsky J, Brody F (2003) Small bowel obstruction after laparoscopic Roux-en-Y gastric bypass. *Surgery* 134:501–505
3. Higa KD, Ho T, Boone KB (2003) Internal hernias after laparoscopic Roux-en-Y gastric bypass: incidence, treatment, and prevention. *Obes Surg* 13:350–354
4. Schauer P, Ikramuddin S, Hamad G, Gourash W (2003) The learning curve for laparoscopic Roux-en-Y gastric bypass is 100 cases. *Surg Endosc* 17:212–215
5. Podnos YD, Jimenez JC, Wilson SE, Stevens CM, Nguyen NT (2003) Complications after laparoscopic gastric bypass: a review of 3,464 cases. *Arch Surg* 138:957–961
6. Brolin RE, Kenler HA, Gorman JH, Cody RP (1992) Long-limb gastric bypass in the superobese: a prospective randomized study. *Ann Surg* 215:387–395
7. Bocker J, Vasile J, Zager J, Goodman E (2004) Intussusception: an uncommon cause of postoperative small bowel obstruction after gastric bypass [see comment]. *Obes Surg* 14:116–119
8. Majeski J, Fried D (2004) Retrograde intussusception after Roux-en-Y gastric bypass surgery. *J Am Coll Surg* 199:988–989
9. Duane TM, Wohlgenuth S, Ruffin K (2000) Intussusception after Roux-en-Y gastric bypass. *Am Surg* 66:82–84
10. Karlstrom L, Kelly KA (1989) Ectopic jejunal pacemakers and gastric emptying after Roux gastrectomy: effect of intestinal pacing. *Surgery* 106:867–871
11. Awais O, Raftopoulos I, Luketich JD, Courcoulas A (2005) Acute, complete proximal small bowel obstruction after laparoscopic gastric bypass due to intraluminal blood clot formation. *Surg Obes Related Dis* 1:418–422, discussion 422–423
12. Charles A, Domingo S, Goldfadden A, Fader J, Lampmann R, Mazzeo R (2005) Small bowel ischemia after Roux-en-Y gastric bypass complicated by pregnancy: a case report. *Am Surg* 71:231–234
13. Kakarla N, Dailey C, Marino T, Shikora SA, Chelmow D (2005) Pregnancy after gastric bypass surgery and internal hernia formation. *Obstet Gynecol* 105(5 Pt 2):1195–1198
14. Loar PV III, Sanchez-Ramos L, Kaunitz AM, Kerwin AJ, Diaz J (2005) Maternal death caused by midgut volvulus after bariatric surgery. *Am J Obstet Gynecol* 193:1748–1749
15. Schweitzer MA, DeMaria EJ, Broderick TJ, Sugerman HJ (2000) Laparoscopic closure of mesenteric defects after Roux-en-Y gastric bypass. *J Laparoendosc Adv Surg Tech Part A* 10:173–175
16. Brolin RE (1995) The antiobstruction stitch in stapled Roux-en-Y enteroenterostomy. *Am J Surg* 169:355–357
17. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich J (2000) Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg* 232:515–529
18. Taylor JD, Leitman IM, Rosser JB, Davis B, Goodman E (2006) Does the position of the alimentary limb in Roux-en-Y gastric bypass surgery make a difference? *J Gastrointest Surg* 10:1397–1399
19. Eid GM, Collins J (2005) Application of a trocar wound closure system designed for laparoscopic procedures in morbidly obese patients. *Obes Surg* 15:871–873
20. Blachar A, Federle MP (2002) Gastrointestinal complications of laparoscopic Roux-en-Y gastric bypass surgery in patients who are morbidly obese: findings on radiography and CT. *AJR Am J Roentgenol* 179:1437–1442
21. Blachar A, Federle MP, Brancatelli G, Peterson MS, Oliver JH, Li W (2001) Radiologist performance in the diagnosis of internal hernia by using specific CT findings with emphasis on transmesenteric hernia. *Radiology* 221:422–428
22. Lockhart M, Tessler FN, Canon CL, Smith J Kevin, Larrison MC, Fineberg NS, Roy BP, Clements RH (2007) Internal hernia after gastric bypass: sensitivity and specificity of seven CT signs with surgical correlation and controls. *AJR Am J Roentgenol* 188:745–750
23. Higa KD, Boone KB, Ho T (2000) Complications of the laparoscopic Roux-en-Y gastric bypass: 1,040 patients—what have we learned? *Obes Surg* 10:509–513
24. Garza E Jr, Kuhn J, Arnold D, Nicholson W, Reddy S, McCarty T (2004) Internal hernias after laparoscopic Roux-en-Y gastric bypass. *Am J Surg* 188:796–800
25. Szomstein S, Kaidar-Person O, Naberezny K, Cruz-Correa M, Rosenthal R (2006) Correlation of radiographic and endoscopic evaluation of gastrojejunal anastomosis after Roux-en-Y gastric bypass. *Surg Obes Related Dis* 2:617–621
26. Nguyen NT, Stevens CM, Wolfe BM (2003) Incidence and outcome of anastomotic stricture after laparoscopic gastric bypass. *J Gastrointest Surg* 7:997–1003, discussion 1003