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# Bowel Obstruction after Laparoscopic Roux-en-Y Gastric Bypass

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**Background:** Bowel obstruction has been frequently reported after laparoscopic Roux-en-Y gastric bypass (LRYGBP). The aim of this study was to review our experience with bowel obstruction following LRYGBP, specifically examining its etiology and management and to strategize maneuvers to minimize this complication.

**Methods:** We retrospectively reviewed the charts of 9 patients who developed postoperative bowel obstruction after LRYGBP. Each chart was reviewed for demographics, timing of bowel obstruction from the primary operation, etiology of obstruction, and management.

**Results:** 9 of our initial 225 patients (4%) who underwent LRYGBP developed postoperative bowel obstruction. The mean age was  $46 \pm 12$  years, with mean BMI  $47 \pm 9$  kg/m<sup>2</sup>. 6 patients developed early bowel obstruction, and 3 patients developed late bowel obstruction. The mean time interval for development of early bowel obstruction was  $16 \pm 16$  days. The causes for early bowel obstruction included narrowing of the jejunojejunostomy anastomosis (n=3), angulation of the Roux limb (n=2), and obstruction of the Roux limb at the level of the transverse mesocolon (n=1). The mean time interval for development of late bowel obstruction was  $7.4 \pm 0.5$  months. The causes for late bowel obstruction included internal herniation (n=2) and adhesions (n=1). 6 of 9 bowel obstructions (66%) were considered technically related to the learning curve of the laparoscopic approach. Eight of the 9 patients required operative intervention, and 6 of the 8 reoperations were managed laparoscopically. Management included laparoscopic bypass of the jejunojejunostomy obstruction site (n=5), open reduction of internal hernia (n=2), and laparoscopic lysis of adhesion (n=1).

**Conclusions:** Bowel obstruction is a frequent complication after LRYGBP, particularly during the learn-

ing curve of the laparoscopic approach. Specific measures should be instituted to minimize bowel obstruction after LRYGBP as most of these complications are considered technically preventable.

**Key words:** Morbid obesity, bariatric surgery, laparoscopy, gastric bypass, bowel obstruction

## Introduction

Since the first description in 1994,<sup>1</sup> laparoscopic Roux-en-Y gastric bypass (LRYGBP) has gained tremendous attention by both surgeons and patients. Advantages of LRYGBP compared with open gastric bypass include less postoperative pain, shorter hospital stay, and faster recovery.<sup>2</sup> Despite these benefits, certain complications have been shown to increase with the development of LRYGBP. In a review of 3,464 published LRYGBP cases, Podnos et al<sup>3</sup> found that the incidence of early and late bowel obstruction was higher after LRYGBP compared with the open gastric bypass; early bowel obstruction was not reported in 8 recently published open gastric bypass series, but had been reported in 3 of 10 recently published LRYGBP series. In addition, the incidence of late bowel obstruction was significantly higher after laparoscopic compared with open gastric bypass (3.15% vs 2.11%, respectively,  $P=0.02$ ).<sup>3</sup> We hypothesized that the higher rate of bowel obstruction could be related to the learning curve of the laparoscopic approach. The aim of this study was to review our experience with bowel obstruction after LRYGBP with an emphasis on examining the etiology of obstruction and its management, and developing strategies to minimize this complication.

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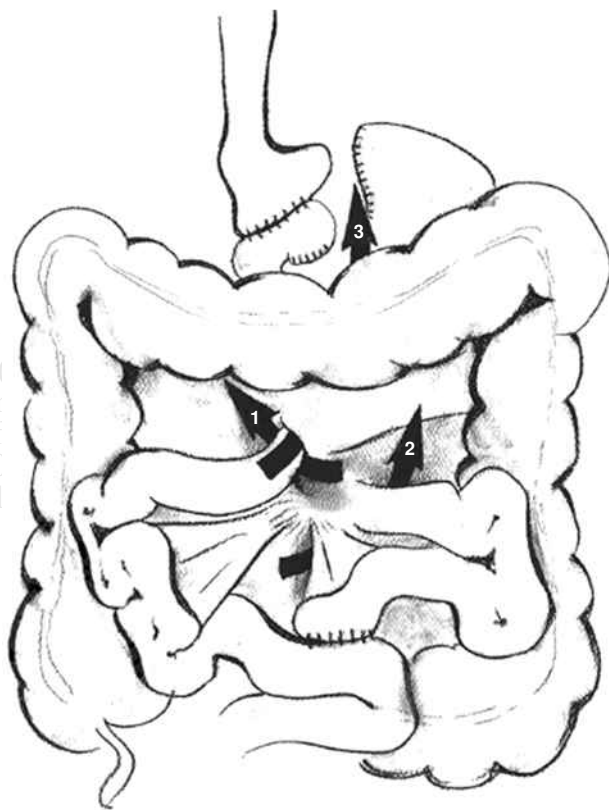
## Materials and Methods

We retrospectively reviewed the charts of nine patients who developed a bowel obstruction after LRYGBP. The records of these patients were analyzed for demographics, time interval between the primary operation and development of bowel obstruction, etiology of obstruction, operative management, and morbidity. This retrospective review was approved by the University of California, Irvine Medical Center Institutional Review Board.

### Operative Technique

Our technique of LRYGBP has been previously described.<sup>2</sup> Briefly, the procedure was performed through five abdominal trocars (three 5-mm and two 12-mm). Abdominal insufflation was achieved using a Veress needle, and intraabdominal pressure was maintained at 15 mmHg. Patients were placed in a reverse Trendelenburg position. The dissection began directly on the lesser curvature of the stomach to gain entrance into the lesser sac. A gastrotomy was created on the lesser curve of the stomach. The anvil of the circular stapler (Premium Plus CEEA 25, U.S. Surgical Corp, Norwalk, CT) was placed intraabdominally, inserted into the stomach, and positioned through the anterior gastric wall 1 cm below the gastroesophageal junction. Multiple linear staplers were applied adjacent to the anvil to create a 15- to 20-mL gastric pouch. The remaining gastrotomy was suture closed.

Patients were placed in the neutral position for creation of the jejunojejunostomy. The jejunum and its mesentery were divided 30 cm distal to the ligament of Treitz. The Roux limb was measured at 75-150 cm based on the patient's body mass index (BMI). The jejunojejunostomy anastomosis was created with the 60-mm linear stapler. The remaining enterotomy was either staple or suture closed. The Roux limb was routed retrocolic, retrogastric through the transverse mesocolon window. The gastrojejunostomy anastomosis was created with the circular stapler placed through the end of the Roux limb. The remaining enterotomy in the Roux limb was staple closed. The jejunojejunostomy and transverse mesocolon mesenteric defects and Petersen defect (Figure 1) were closed, and the anti-obstruc-



**Figure 1.** Three potential spaces that could lead to internal herniation (1 - Petersen hernia defect, 2 - jejunojejunostomy mesenteric defect, and 3 - transverse mesocolon defect).

tion suture was placed in the latter part of our series.

### Operative Management of Bowel Obstruction

Operative management of bowel obstruction after LRYGBP included laparoscopic bypass of the jejunojejunostomy obstruction site, open reduction of internal hernia at the jejunojejunostomy and transverse mesocolon defect, and laparoscopic lysis of adhesion. We performed a laparoscopic proximal enteroenterostomy for management of bowel obstruction at the jejunojejunostomy in five cases (Figures 2a and 2b). A stay suture was placed between the dilated Roux limb proximal to the obstruction site and the decompressed small bowel distal to the obstruction site. An enterotomy was created in the two jejunal limbs. The luminal content in the dilated Roux limb was suctioned. A side-to-side jejunojejunostomy was created with a 60-

mm linear stapler (Figure 3). The remaining enterotomy was suture closed in two layers (Figures 4a and 4b). In one case, laparoscopic lysis of adhesions was performed. Both patients with bowel obstruction from internal herniation were managed by open laparotomy with reduction of the small bowel and closure of the defects.

## Results

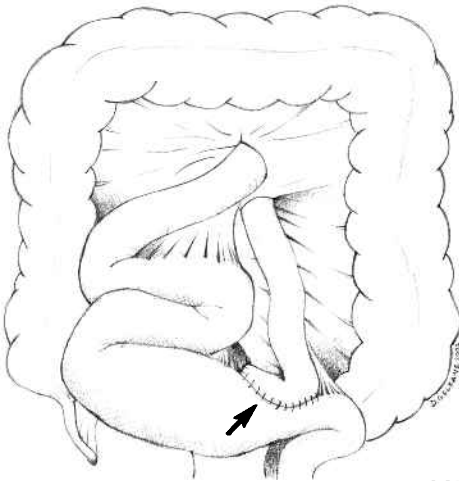
Nine patients (4%) in our initial 225 cases developed postoperative bowel obstruction after LRYGBP. The mean age was  $46 \pm 12$  years, with mean BMI  $47 \pm 9$  kg/m<sup>2</sup>. Early bowel obstruction developed in 6 patients, and late bowel obstruction developed in 3 patients (Table 1). The mean time interval for development of early bowel obstruction was  $16 \pm 16$  days. The causes for early bowel obstruction were narrowing of the jejunojejunostomy anastomosis (n=3), angulation of the Roux

limb (n=2), and narrowing of the Roux limb at the level of the transverse mesocolon (n=1). Narrowing of the jejunojejunostomy occurred as a result of our stapled closure technique of the jejunojejunostomy enterotomy; these three patients required laparoscopic exploration and creation of a new enteroenterostomy proximal to the obstruction site. Two obstructions occurred as a result of angulation of the Roux limb at the jejunojejunostomy; one of the two patients did not have the antiobstruction suture placed at the primary operation, but the other patient did have the antiobstruction suture placed at the primary operation. One patient developed an obstruction in the Roux limb at the transverse mesocolon tunnel; this obstruction resolved with conservative management (nothing by mouth and fluid hydration). The mean operative time in the five laparoscopic reoperations for early bowel obstruction was  $50 \pm 14$  min. Postoperative complications included a single case of cellulitis at a trocar site. The mean length of hospital stay was  $3.2 \pm 1.5$  days after laparoscopic reexploration.

**Table 1. Etiology of bowel obstruction in 225 consecutive laparoscopic bypasses**

Patient	Age	BMI	Timing*	Location of Bowel Obstruction	Etiology	Treatment
1	48	45	7 days	Narrow jejunojejunostomy	Stapled closure of jejunojejunostomy	Laparoscopic proximal enteroenterostomy
2	48	47	8 mons	Internal hernia at jejunojejunostomy mesentery	Failure to close mesenteric defects	Open reduction
3	52	56	14 days	Narrow jejunojejunostomy	Stapled closure of jejunojejunostomy	Laparoscopic proximal enteroenterostomy
4	50	48	46 days	Angulation of jejunojejunostomy	Failure to place antiobstruction suture	Laparoscopic proximal enteroenterostomy
5	57	41	20 days	Narrow jejunojejunostomy	Stapled closure of jejunojejunostomy	Laparoscopic proximal enteroenterostomy
6	32	43	7 mons	Internal Hernia at transverse mesocolon mesentery	Failure to close mesenteric defects	Open reduction
7	32	56	4 days	Roux limb obstruction at transverse mesocolon	Edema	Conservative management
8	42	40	7.3 mons	Obstruction at jejunojejunostomy	Adhesions	Laparoscopic lysis of adhesions
9	57	43	5 days	Angulation of jejunojejunostomy	Unknown	Laparoscopic proximal enteroenterostomy

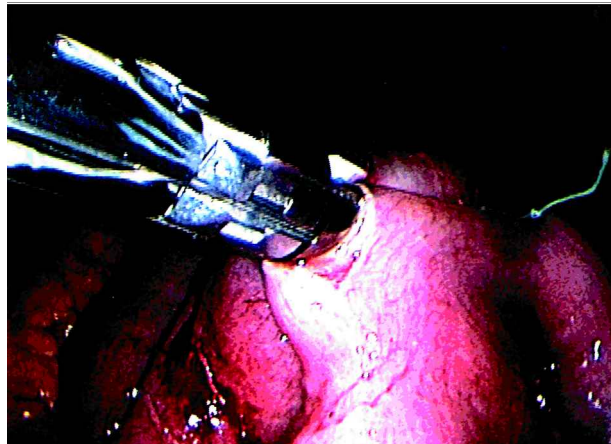
BMI = body mass index. \*Time interval between primary operation and obstructive complication. Mons = months.



**Figure 2A.** Schematic drawing of bowel obstruction at the jejunojunostomy (arrow) after laparoscopic gastric bypass.



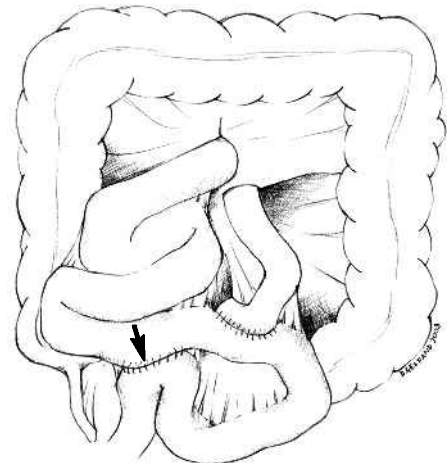
**Figure 2B.** Laparoscopic view demonstrating bowel obstruction at the jejunojunostomy. White arrow points to dilated Roux limb; small arrow points to biliopancreatic limb; and large arrow points to site of obstruction.



**Figure 3.** The 60-mm linear stapler is used for creation of the proximal enteroenterostomy.



**Figure 4A.** The remaining enterotomy has been suture closed in two layers (arrow).



**Figure 4B.** Schematic drawing of proximal enteroenterostomy (arrow) for management of bowel obstruction at the jejunojunostomy.

The mean time interval for development of late bowel obstruction was  $7.4 \pm 0.5$  months. The causes for late bowel obstruction included internal herniation ( $n=2$ ) and adhesions ( $n=1$ ). Internal herniation occurred through the jejunojejunostomy ( $n=1$ ) and transverse mesocolon defect ( $n=1$ ). These defects were not closed in our initial cases. Both of these cases required open laparotomy and reduction of internal herniation. One patient developed a bowel obstruction from a single band of adhesion. This patient underwent a successful laparoscopic lysis of adhesions and was discharged on postoperative day 1.

Six of 9 bowel obstructions (66%) in this series were considered to be technically related to the learning curve of the laparoscopic approach. These 6 bowel obstructions (6%) occurred within the first 100 cases compared with only 3 bowel obstructions (2.4%) in the later 125 cases ( $P=0.1$ , Fisher's Exact test). Eight of 9 patients required operative intervention; one patient with Roux limb obstruction at the transverse mesocolon was managed conservatively. Six of the 8 bowel obstructions requiring operative intervention were managed laparoscopically. Overall, operative management included laparoscopic bypass of the jejunojejunostomy obstruction site ( $n=5$ ), open reduction of internal hernia at the jejunojejunostomy and transverse mesocolon defect ( $n=2$ ), and laparoscopic lysis of adhesions ( $n=1$ ).

## Discussion

The results from this study demonstrate that bowel obstruction after LRYGBP appears to be related to the learning curve of the procedure. In our experience, 66% of bowel obstructions were considered technically preventable. The percentage of bowel obstruction decreased from 6% in the first 100 cases to 2.4% in the latter 125 cases. Operative steps that were instituted to minimize postoperative bowel obstruction included closure of all three mesenteric defects, placement of an antiobstruction suture, and suture closure of the jejunojejunostomy enterotomy defect. The laparoscopic management of postoperative bowel obstruction in this series was safe and feasible, because 75% of cases requiring operative

intervention were managed laparoscopically.

Small bowel obstruction is a known complication after open gastric bypass, and its etiology is usually the result of postoperative adhesions or internal hernia.<sup>3</sup> These bowel obstructions generally occur late in the follow-up period. In contrast, results of multiple LRYGBP series have suggested that the timing of bowel obstruction after LRYGBP is earlier than that after open gastric bypass. Early bowel obstruction has not been reported in 8 recently published open gastric bypass series but was reported in 10 (1.7%) of 577 LRYGBP cases.<sup>3</sup> In our series, 6 of 9 postoperative bowel obstructions occurred within 6 weeks after LRYGBP.

Early bowel obstruction after LRYGBP is commonly a result of a technical narrowing of the afferent limb at the jejunojejunostomy. In this series, 3 of 6 early bowel obstructions occurred because of narrowing of the afferent limb at the jejunojejunostomy. We utilized the 60-mm linear stapler to create a side-to-side jejunojejunostomy. In our initial laparoscopic cases, the remaining enterotomy defect after creation of the jejunojejunostomy was closed using the linear stapler (double-stapling technique); this technique frequently resulted in obstruction. We have since altered our technique to suture closure of the enterotomy defect using either interrupted or continuous sutures. Schauer et al<sup>4</sup> similarly reported two early jejunojejunostomy obstructions in their series of 275 cases. They also utilized the double-stapling technique to close the enterotomy defect. The advantage of a stapled closure of the enterotomy defect is the shorter operative time to perform the task. The disadvantage of a stapled closure of the enterotomy defect is the potential for obstruction if too much tissue is taken or potential for leak if inadequate tissue is taken. Madan et al<sup>5</sup> also expressed similar obstructive concern with the double-stapling technique and described the triple-stapling technique for creation of the jejunojejunostomy. Their technique consists of two applications of the linear stapler to create the jejunojejunostomy. The linear staplers are applied bidirectionally through the same jejunal enterotomy for creation of the jejunojejunostomy. The enterotomy defect is then stapled closed transversely. In this series, all bowel obstructions at the jejunojejunostomy were managed laparoscopically by creation of an enteroenterostomy proximal to the obstruction site.

Another common cause of bowel obstruction after LRYGBP is internal herniation of small bowel through the potential spaces created during the operation. These potential spaces include the jejunojejunostomy mesenteric defect, the transverse mesocolon defect, and the Petersen space. During our early laparoscopic cases, these potential spaces were not closed and we observed internal herniation through both the transverse mesocolon defect and the jejunojejunostomy mesenteric defect. We have since altered our technique to close all three potential spaces. In addition, the lack of postoperative adhesions after LRYGBP can possibly increase the potential for internal herniation in these spaces. Internal herniation is the most common cause for bowel obstruction after LRYGBP in most series (Table 2).<sup>6-14</sup> Higa et al<sup>13</sup> reported that internal herniation occurred in 63 of 2000 patients (3.1%) who underwent LRYGBP. Champion et al<sup>7</sup> reported internal herniation in 6 of 13 bowel obstructions in their series of 711 laparoscopic gastric bypasses. The laparoscopic approach for management of internal hernia is certainly possible and is often based on the extent of bowel dilation and site of bowel obstruction. In our series, both patients with internal herniation required open reduction, because the obstruction was distal with concomitant severe

bowel dilation that prohibited safe laparoscopic entry.

The incidence of late bowel obstruction as a result of postoperative adhesions following open gastric bypass was reported to be 2.1%.<sup>3</sup> Laparoscopic surgery has been demonstrated to reduce the amount of postoperative adhesions compared with the open surgery. However, postoperative adhesions can still be problematic after LRYGBP. In our series, one patient developed bowel obstruction from a single adhesive band obstructing the jejunojejunostomy. Laparoscopic lysis of adhesion was performed in this case. Champion et al<sup>7</sup> also reported 5 adhesive bowel obstructions in his series of 711 cases.

Bowel obstruction can also occur at the Roux limb where it crosses the transverse mesocolon. We observed one such complication. The patient was managed conservatively with good outcome. Others have reported late obstruction at this site as a result of scarring at the transverse mesocolon defect.<sup>7,11</sup> Gould et al<sup>6</sup> reported an obstruction of the Roux limb, which had twisted in the retrocolic tunnel. A twisted Roux limb can result in obstruction and possibly ischemic bowel, resulting in a leak. To our knowledge, this complication had not been described in the open bariatric surgery literature. It is prudent for surgeons performing LRYGBP to

**Table 2. Bowel obstruction in selected large series of laparoscopic gastric bypass**

Causes of bowel obstruction	Present study	Gould et al <sup>6</sup>	Champion et al <sup>7</sup>	Perugini et al <sup>8</sup>	Dresel et al <sup>9</sup>	Schauer et al <sup>4</sup>	DeMaria et al <sup>10</sup>	Papasavas et al <sup>11</sup>	Kligman et al <sup>12</sup>	Higa et al <sup>13</sup>	Suter et al <sup>14</sup>
No. of cases out of total (%)	9/225 (4%)	7/223 (3.1%)	13/711 (1.8%)	10/188 (4.8%)	5/100 (5.0%)	4/275 (1.5%)	9/281 (3.2%)	18/246 (7.3%)	5/160 (3.1%)	63/2,000 (3.1%)	3/107 (2.8%)
Angulation of Roux limb (N)	1	1									1
Jejunojunostomy obstruction (N)	3			3		2		3	2		1
Internal hernia (N)	2	1	6		5	1	5	3	2	63	1
Adhesions (N)	1	2	5	6		1		6	1		
Transverse mesocolon obstruction (N)	2	1	1					3			
Other (N)		2	1	1			4	3			

always inspect the position of the Roux limb as it enters the transverse mesocolon to prevent this dreaded complication. An alternative to the retrocolic method is the antecolic approach. However, the antecolic, antegastric path of the Roux limb does not completely eliminate the risk for obstruction, because the mesenteric defect is still a potential site for obstruction.

Other potential causes for bowel obstruction include angulation of the Roux limb and herniation of small bowel through an abdominal wall hernia defect. Brolin<sup>15</sup> reported bowel obstruction occurring at the afferent limb of the jejunojunostomy after open gastric bypass and advocated the placement of an "antiostruction suture" at the jejunojunostomy to prevent this complication. We observed one such complication in our series and have altered our technique to routinely place the antiostruction suture. Bowel obstruction from incarceration of abdominal wall hernia has been reported by various authors. Abdominal wall hernia is common in morbidly obese patients undergoing gastric bypass and poses a potential site for bowel herniation in the postoperative period.

The timing of bowel obstruction is related to the etiology for the obstruction. Bowel obstruction secondary to technical narrowing of the jejunojunostomy usually presents early after the primary surgery as a total or partial obstruction. In this series, all 3 patients with bowel obstruction at the jejunojunostomy presented within the first 14 days after surgery. Bowel obstruction secondary to internal hernias or angulation of the Roux limb at the jejunojunostomy usually presents at a later period. The two patients with bowel obstruction as a result of internal hernia presented at 7 and 8 months after surgery, while the two patients with angulation of the afferent limb at the jejunojunostomy presented with obstructive symptoms at 5 and 46 days after surgery.

In conclusion, bowel obstruction is a frequent complication after laparoscopic gastric bypass. However, the majority of the causes for bowel obstruction in this series were related to the learning curve of the laparoscopic procedure. Alteration in our techniques has minimized future development of bowel obstruction due to internal hernia, angulation of the afferent limb, and narrowing of the afferent limb at the jejunojunostomy.

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