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Original article

Impact of complete mesenteric closure on small bowel obstruction and internal mesenteric hernia after laparoscopic Roux-en-Y gastric bypass

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Abstract

Background: Although it is generally accepted that closure of mesenteric defects after laparoscopic Roux-en-Y gastric bypass (LRYGB) reduces the incidence of small bowel obstruction (SBO), data supporting this belief are inconsistent. After a spike in acute SBO cases in our LRYGB patients, we changed our technique of mesenteric closure. The objective of this study was to determine whether modification of our technique of mesenteric closure would decrease the incidence of SBO and internal hernia after LRYGB.

Methods: The records of 872 consecutive patients who had antecolic LRYGB by 1 surgeon over a 9-year interval were reviewed for acute SBO. The first 654 patients, mean follow up = 100 ± 12 months, had incomplete mesenteric closure versus complete closure in 218 remaining patients, mean follow up = 40 ± 14 months. Minimum follow up was 1 year.

Results: Total incidence of acute SBO was 4.0% (35/872), including 4.4% (29/654) in the incomplete closure group versus 2.8% (6/218) in the complete closure patients. Seventeen (2.6%) of the incomplete closure patients with acute SBO had internal hernias versus 1 (.5%) in the complete closure group. Twenty-six patients with incomplete closure developed symptoms of SBO and subsequently had elective repair of mesenteric hernias versus none in complete closure group ($P < .02$). Postoperative morbidity and mortality rates after surgery for SBO were 30% and 7.4% in incomplete group versus zero in patients with complete closure.

Conclusion: Complete closure of mesenteric defects in antecolic LRYGB resulted in a significant reduction in internal mesenteric hernias. Complications were also reduced after operations for SBO in patients who had complete mesenteric closure. (Surg Obes Relat Dis 2013;9:850–855.) © 2013 Published by Elsevier Inc. on behalf of American Society for Metabolic and Bariatric Surgery.

Keywords: Bariatric surgery; Mesenteric hernia; Small bowel obstruction; Gastric bypass; Laparoscopic surgery

Small bowel obstruction (SBO) is a recognized complication of laparoscopic Roux-en-Y gastric bypass (LRYGB) with a reported incidence varying from 1.9% to 9% [1–4]. The incidence of internal hernias after LRYGB ranges from 3.1% to 5% [5,6]. Although it is generally accepted that closure of mesenteric defects after LRYGB reduces the incidence of postoperative SBO, data supporting this belief are inconsistent. After a rash of acute SBO in our patients who had antecolic LRYGB and partial closure of the mesenteric defect, we changed our technique of mesenteric closure in June 2006. This report compares the incidence of postoperative SBO between patients who had partial and complete closure of the mesenteric defect at the jejunojejunostomy.

Methods

Patients

Records of 872 consecutive patients who underwent antecolic antegastric LRYGB between January 1, 2002, and June 30, 2011, were reviewed. All of the operations were performed by 1 surgeon at Saint Peters University

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Hospital, New Brunswick, New Jersey, or at the University Medical Center at Princeton, New Jersey. Patients in whom acute SBO or symptoms suggestive of partial small bowel obstruction (PSBO) developed were the focus of this review. The first 654 patients had partial mesenteric closure, whereas the remaining 218 patients had complete mesenteric closure, as shown in Fig. 1. Mean follow up in the incomplete closure group was 100 + 12 months versus 40 + 14 months in the complete closure group. The minimum follow-up was 1 year.

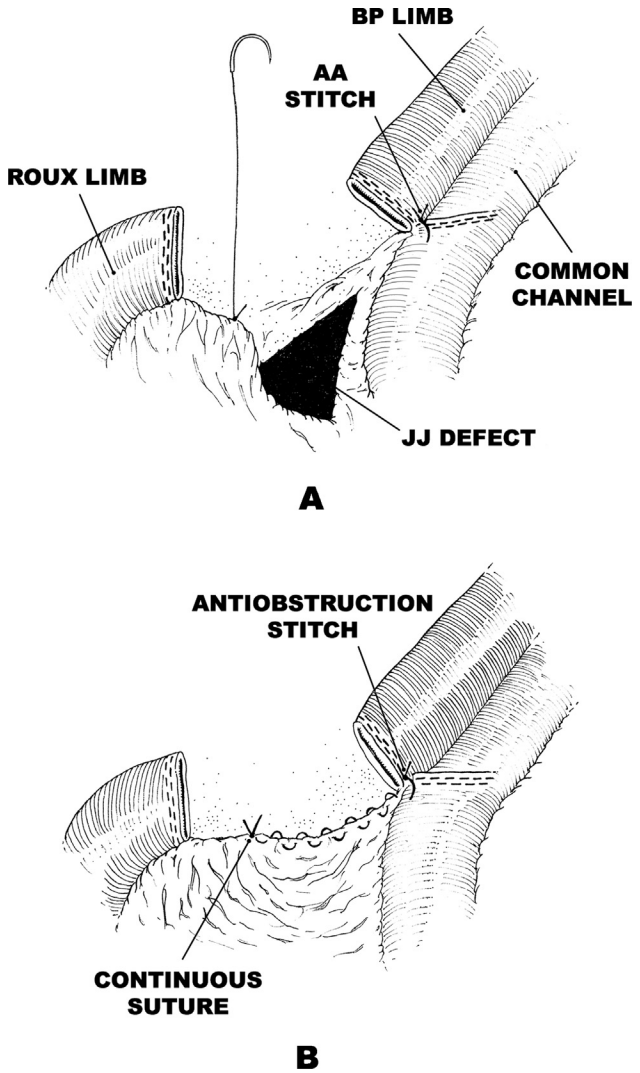

Fig. 1. (A) The antiobstruction (AA) stitch is placed between the biliopancreatic (BP) and Roux limb at the proximal end of the jejunojejunostomy to properly align the anastomosis. Closure of the jejunojejunostomy (JJ) defect (dark shaded) is started in the cut edge of the mesentery of the Roux limb approximately 2 cm from the mesenteric border and is performed using a continuous 2-0 silk suture. (B) The continuous silk suture joins the cut edge of the mesentery of the Roux limb and the mesentery of the biliopancreatic (BP) limb beginning at the root of the mesentery. The last bite of this suture typically extends into the bowel and is tied to the most medial antiobstruction stitch.

Surgical technique

All patients had antecolic, antegastric LRYGB. The Roux limb length varied between 80 and 150 cm depending on the preoperative body mass index (BMI). After transecting the jejunum at 20–30 cm distal to the ligament of Treitz, a side-to-side jejunojejunostomy was performed using the Echelon Stapler (Ethicon Endo-Surgery, Cincinnati, OH). The enterotomy was closed transversely using 1 or 2 applications of the Ethicon linear stapler. Two or 3 antiobstruction stitches of 2-0 silk were then placed at the jejunojejunostomy to prevent kinking [7]. In the first 654 patients, these stitches were extended into the mesentery of the biliopancreatic limb to close a portion of jejunojejunostomy defect. In the remaining 218 patients, the closure commenced at the root of mesentery of the biliopancreatic limb and continued to the jejunojejunostomy using a continuous 2-0 silk suture, as shown in Fig. 1. This suture was tied to the nearest antiobstruction stitch.

Statistical analysis

Time interval data were expressed as the mean ± standard deviation. All statistical analysis was performed with Graphpad Software (Graphpad Software Inc., La Jolla, CA) using the χ^2 and Fishers exact test. A P value $< .05$ was considered significant.

Results

Of the 872 patients who had LRYGB, acute SBO developed in 35 patients, including 4.4% (29/654) in the incomplete closure group versus 2.8% (6/218) among complete closure patients ($P = .42$) Characteristics and etiology of patients who developed acute SBO are shown in Table 1. All patients with acute SBO required surgical intervention. Mesenteric internal hernia (MIH) was the most common cause of acute SBO, accounting for 17 of 35

Table 1
Characteristics and etiology in patients with acute SBO

	Partial Closure	Complete Closure
Number of patients	29	6
Age (years)	42 + 12	44 + 17
Gender (F:M)	22:7	4:2
Mesenteric hernia	17	1
Adhesions	3	2
Technical kink	2	0
JJ stricture	2	0
Umbilical hernia	1	0
Port site hernia	2	1
Volvulus	2	1
BP limb obstruction	0	1
Intussusception	1	0

BP = biliopancreatic.; F = female; JJ = jejunojejunostomy; M = male; SBO = small bowel obstruction.

(49%) cases in the incomplete closure group and 1 of 6 cases (17%) of SBO in the complete closure group. All MIHs occurred at the jejunojejunostomy defect shown in Fig. 1. Other causes of acute SBO included 3 abdominal wall hernias, 1 Richter's hernia at the trocar site, and 2 incarcerated umbilical hernias. Adhesions were purely responsible for SBO in 5 patients, 2 of whom had associated volvulus. There were 2 cases of kinking of the Roux limb at the jejunojejunostomy that were caused by narrowing of the lumen of the bowel at the stapled closure of the enterotomy. Small bowel intussusception associated with volvulus was responsible for 1 case.

The morbidity and mortality rates associated with acute SBO were 30% and 7.4%, respectively, in the incomplete group versus zero complications in patients with complete closure. Postoperative complications included sepsis in 3 patients, wound infection in 2, and recurrent SBO in 1. Two of the 3 patients with sepsis died, including 1 who developed an incarcerated umbilical hernia with subsequent perforation of the proximal bowel. The second death was caused by perforation associated with strangulated intussusception and volvulus at the jejunojejunostomy.

Internal hernia at the jejunojejunostomy accounted for 44 of the 65 cases of partial or complete SBO (68%) in this series. The 6.6% incidence of MIH in the partial closure group was significantly greater versus the .45% incidence in complete closure patients ($P < .0001$). Seventeen (2.6%) of the 654 incomplete closure patients with acute SBO had internal hernias versus one of 218 (.5%) in the complete closure group ($P = .056$).

Patients with acute SBO caused by MIH presented at a mean interval of 34.7 months postoperatively. Conversely, acute SBO resulting from other causes developed at a mean of 13.8 months postoperatively. There was no difference in mean BMI drop in patients with acute SBO due to MIH in comparison with patients who had acute SBO due to other causes.

Thirty patients underwent elective laparoscopy for symptoms suggestive of intermittent SBO, including 29 partial closure patients and 1 patient who had complete mesenteric closure. Likely causes of obstructive symptoms among patients who had elective laparoscopy for intermittent episodes of SBO are shown in Table 2. Twenty-six patients with incomplete closure and intermittent symptoms of SBO subsequently had elective repair of MIH versus none in the complete closure group ($P < .008$). Elective repair of MIH was performed with interrupted 2-0 silk sutures [8].

Table 2
Characteristics and etiology in patients with intermittent SBO

	Partial closure	Complete closure
Number of patients	29	1
Age (years)	40 + 12	23
Gender (F:M)	23:6	1 : 0
Mesenteric hernia	26*	0
Adhesions	2	1
Umbilical hernia	1	0

F = female; M = male; SBO = small bowel obstruction.
*$P < .008$ versus complete closure.

Discussion

The early published series of LRYGB report a considerably higher incidence of acute SBO than was observed after open Roux-en-Y gastric bypass (RYGB) [3,4]. Moreover, MIH was the most common cause of SBO in LRYGB patients. Conversely, MIH is relatively rare after open RYGB. Possible explanations for the high incidence of MIHs after LRYGB include paucity of adhesions resulting in greater mobility of the bowel and lack of secure closure of the mesenteric defects. Many of the early techniques of LRYGB did not incorporate complete closure of the mesenteric defects. The technique of closure of the jejunojejunostomy defect that was used in our initial experience with LRYGB was learned from one of the pioneers in advanced laparoscopic surgery.

There is considerable controversy regarding the position of the Roux limb and incidence of acute SBO after LRYGB. Retrocolic RYGB involves creation of 3 potential mesenteric defects, including (1) the Petersen's defect, which is the space between the Roux limb mesentery and transverse mesocolon, (2) the mesenteric defect at the level of the jejunojejunostomy, and (3) the defect in the mesocolon created by retrocolic positioning of the Roux limb. In antecolic LRYGB, the jejunojejunostomy and Petersen's defect are essentially one large contiguous space. A comparative study of 454 antecolic and 300 retrocolic LRYGB by Escalona et al. reported a higher incidence of both SBO (9.3% versus 1.8%) and internal hernia (86% versus 38%) in the retrocolic group [9]. Champion and Williams reported a significant decrease in SBO after changing from retrocolic to antecolic techniques of LRYGB [10]. Conversely, Carmody et al. reported a significant reduction in SBO after conversion to a retrocolic approach that included closure of all of the mesenteric defects [11]. The favored technique in each of these reports was associated with the shortest postoperative follow-up.

Routine closure of mesenteric defects during LRYGB remains somewhat controversial. Madan et al. reported no cases of SBO caused by MIH in a series of 387 consecutive LRYGB patients followed for a mean 24 months, who did not have closure of mesenteric defects [12]. Conversely, Abasbassi et al. reported a 9.6% incidence of acute SBO, including a 6.9% incidence of MIHs in a series of 652 patients who had antecolic LRYGB with a mean follow-up of 45 months [13]. Abasbassi's technique in performing the jejunojejunostomy and mesenteric closure was virtually the same as used in our partial closure. The Abasbassi group now completely closes the jejunojejunostomy defect with interrupted nonabsorbable sutures. In our study there was a

significantly lower incidence of MIHs in patients who had complete mesenteric closure (.45%) in comparison with patients who had partial closure (6.6%). All MIHs in our patients occurred at the jejunojejunostomy.

The relationship between the duration of follow-up and the mean time to presentation might account for the wide range of reported incidence of SBO after LRYGB. Finnell et al. reported no MIHs in their series of 300 consecutive antecolic LRYGB patients with a mean follow-up of 1 year in whom the mesenteric defects were not closed [14]. Likewise, Cho et al. reported only 3 MIHs in a series of 1400 consecutive patients with a mean follow-up of 11 months who underwent antecolic LRYGB without division of the mesentery or closure of mesenteric defects [15]. In our study, 47% of the cases of SBO caused by MIH occurred between 24 and 36 months postoperatively. We believe that clinical reports with follow-up intervals <24 months would likely miss many cases of SBO caused by MIH.

Several surgeons have proposed technical modifications that are touted to reduce or eliminate MIHs. Nandipati et al. reported that a counterclockwise orientation of the Roux limb that positions both the jejunojejunostomy anastomosis and ligament of Treitz to the left of the axis of the mesentery was associated with a significant reduction in the incidence of internal hernias (6.9% versus .7%) [16]. The University of Tennessee group likewise believes that a left-sided orientation of the Roux limb with the jejunojejunostomy resting on the transverse colon is sufficient to prevent MIHs after LRYGB despite nonclosure of the mesenteric defects [12,14].

The results of the present study are subject to the inherent limitations of retrospective reviews. Although mean follow-up in the complete closure group is >3 years, the 5-year difference in mean follow-up between the 2 groups might account for the lower incidence of MIHs in patients with complete closure. However, because the peak incidence of SBO caused by MIH occurs between 24 and 36 months postoperatively, the authors believe that follow-up in the complete closure group is sufficient to capture the spike of SBO caused by MIH that was observed in patients with incomplete closure. Moreover, there have been no cases of SBO due to MIH in complete closure patients during the subsequent 16 months after conclusion of this review. Although all of the postoperative complications occurred in patients who had incomplete closure, it seems likely that delayed operative intervention rather than technique of mesenteric closure was primarily responsible for this disparity. The technical aspects of mesenteric closure in each group were consistent throughout the study.

Because MIH is associated with a high incidence of small bowel volvulus, which, in turn, is associated with a high incidence of strangulation, it seems advisable to operate on all patients who develop acute SBO after LRYGB to minimize these risks. There were 3 cases of strangulated volvulus in the present series. All were operated on >24 hours after admission after a failed trial of nasogastric tube decompression. Prompt operative intervention likely would have prevented strangulation in each case.

The catastrophic outcomes associated with strangulated volvulus in our early experience with LRYGB led us to take a much more aggressive approach in evaluation and treatment of patients in whom abdominal pain develops postoperatively. During the past 6 years, we have recommended elective exploratory laparoscopy in LRYGB patients who complain of intermittent episodes of colicky abdominal pain [8]. These episodes are typically associated with nausea, bloating, and subsequent diarrhea. Since adopting this approach, there have been no cases of strangulation obstruction among our LRYGB patients.

Conclusion

Despite the limitations inherent in retrospective reviews, these results provide strong endorsement of complete closure of mesenteric defects during LRYGB. In our hands, complete closure of mesenteric defects in antecolic LRYGB resulted in lower incidence of subsequent acute SBO and a significant reduction in the incidence of MIHs. Complications were also reduced after operations for acute SBO in patients who had complete mesenteric closure.

Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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Editorial comment

Comment on: Impact of complete mesenteric closure on small bowel obstruction and internal mesenteric hernia after laparoscopic Roux-en-Y gastric bypass

Any surgeon who has managed a postbariatric patient with strangulated and infarcted small bowel due to an internal hernia realizes the critical importance of something as seemingly minor as how a several-centimeter defect was closed at the initial operation (or whether it was closed at all). Unfortunately, the available literature on internal hernia and mesenteric closure primarily consists of expert opinions, retrospective and uncontrolled studies with variable follow-up, and observational data [1–3]. Because of the overall low incidence of postbariatric internal hernia ($\leq 5\%$) and the fact that it can often present years after the index surgery, studies having a large sample size and detailed longer-term follow-up are sorely needed.

In this issue of *Surgery for Obesity and Related Diseases,* Drs. Brolin and Kella [4] have chronicled their experience with mesenteric closure during laparoscopic gastric bypass over a 9-year period, and their evolution from a policy of partial closure to complete closure allows for a direct comparison of these two cohorts. They have concluded that complete mesenteric closure is associated with a decrease in subsequent bowel obstructions and complications related to internal hernia, and should be the preferred method. This series will certainly add to the available literature and ongoing debate about how to handle the mesenteric defects created by performing a Roux-en-Y reconstruction.The authors are to be commended for their detailed analysis and multiyear follow-up, 2 factors that are critical to achieving any real insight into this issue and the potentially devastating complications that can result.

Although I wholeheartedly agree with the authors' conclusions and recommendations for routine and complete closure of the mesentery, several aspects of the data and analysis warrant critical commentary. Although most previous studies have compared complete mesenteric closure versus no attempt at closure, this study actually compares 2 closure techniques (partial versus complete) and thus cannot draw any conclusions about the results that would be seen if the defects were left completely open. Although it would seem logical that internal hernia would be higher with no closure of the mesentery, several published series have reported equivalent rates of bowel obstruction and internal hernia [5,6]. One could actually argue that the data from this study lend further support to the lack of benefit of routine closure, because the incidence of acute small bowel obstruction showed no difference ($P = .42$) and the majority of obstructions were not caused by an internal hernia. It is unclear how many of the subsequent surgical explorations that were performed actually revealed a true internal hernia or whether a mesenteric defect was discovered incidentally but was unrelated to the reason for reexploration. Finally, the observed incidence of internal hernia is highly dependent on the length of follow-up. Because the partial closure group predates the complete closure group, this automatically biases the study to find a higher incidence of internal hernia, and the observed difference is likely to decrease or even disappear with equal length of follow-up.

A 2008 survey of the ASMBS membership foundthat there is no consensus among bariatric surgeons on the major technical components of laparoscopic gastric bypass, such as the method of gastrojejunostomy [7]. In contrast, there is almost universal agreement on the aspect of mesenteric closure, with 94% of surgeons routinely closing at least one mesenteric defect. However, although surgeons seem to agree on the general concept of mesenteric closure, the

¨Details make perfection, and perfection is no detail"—Michelangelo