



High Frequency of Internal Hernias After Roux-en-Y Gastric Bypass

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Abstract

Background Internal hernias (IH) after Roux-en-Y gastric bypass (RYGB) are a serious concern among surgeons and are often under-diagnosed due to heterogeneity of clinical manifestations. Our aim is to assess the frequency of IH after a RYGB in symptomatic and asymptomatic patients.

Methods Retrospective analysis of our bariatric surgery unit's database between 2001 and 2013 is obtained. Patients are surgically explored after RYGB due to acute bowel obstruction (ABO), intermittent abdominal pain (IAP), or being asymptomatic (during an elective cholecystectomy) in whom anatomical presence of IH was established. Also, we compared patients with retrocolic and antecolic technique. Statistical analysis with non-parametric tests and chi-square are used.

Results Of the patients, 3,656 submitted to RYGB during this period, 81.9 % (2,993) by laparoscopy and

26.3 % (963) with retrocolic technique. Of the patients, 130 (3.5 %) were surgically explored due to ABO, 27 patients (0.7 %) due to IAP, and 93 patients (2.5 %) submitted to an elective cholecystectomy with exploration for IH. IH was present in 75 % of the obstructed patients, and in 69 %, it was the cause of obstruction. Patients with IAP showed 59 % of IH, but only 15 % have herniated bowel. In asymptomatic patients, 25 % showed IH and none of them have herniated bowel. Retrocolic technique showed a higher risk of whole causes of ABO and IH than the antecolic technique, with a relative risk of 1.53 (1.07–2.17) and 1.62 (1.06–2.47), respectively.

Conclusions A high frequency of IH exists in all operated patients of this series. All members of the bariatric team should be aware of the symptoms related to IH and actively pursue it during follow-up.

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Introduction

In the beginning of bariatric surgery, open Roux-en-Y Gastric Bypass (RYGB) was associated with a low frequency of internal hernias (IH) and it was even considered a rare complication [1–3]. Nowadays, in the laparoscopic era, besides the widely described benefits of laparoscopy, IH incidence has increased progressively. Actually, the frequency of IH has been reported ranging from 1 to 9 % of all laparoscopic RYGB (LRYGB) series [4–6].

Potential sites for IH directly associated to RYGB are the mesenteric gaps created during the procedure, namely, the jejuno-jejunostomy gap (JJG), the Petersen's space (PS; Fig. 1), and in the retrocolic ascending alimentary limb, the transverse mesocolic space (TMS) [2]. It has been reported that in antecolic technique, the most common site of IH is through the JJG but in the retrocolic technique is through the TMS [7]. The consequence of open mesenteric gaps is the presence of an IH, which may or not contain bowel through it (IH with bowel (IHWB) or IH without bowel (IHWOB)). Thus, patients have a lifetime risk for develop a complicated IH as long as the defect exists, making a potential life-threatening condition when an acute bowel obstruction (ABO) occurs.

Clinical manifestations of IH can vary widely, ranging from an asymptomatic patient to intermittent colicky

abdominal pain associated with vomits or even worse, a patient presenting with an ABO [8, 9].

In the case of intermittent abdominal pain (IAP) or asymptomatic patients, few studies have reported the frequency of IH after RYGB, with dissimilar results [2]. Moreover, upper gastrointestinal series, contrast-enhanced multidetector computed tomography (MDCT) scan, and many other work-up that may suggest the diagnosis are often inconclusive [9]; thus, definitive diagnosis remains difficult to obtain [10, 11], requiring in many cases a highly suspicious surgeon and a laparoscopic exploration.

In our experience, the difference between IHWB and IHWOB is clinically relevant since we have observed more frequent symptoms when IHWB occurs and almost no symptoms when IHWOB is present, although at least theoretically the risk of an ABO secondary to IH exists equally for both cases. Therefore, the aim of this study is to assess the frequency of IH after a RYGB in symptomatic (presenting as ABO and as IAP) and asymptomatic patients.

Materials and Methods

Retrospective analysis of the electronic database of the Bariatric Surgery Program at the Clinical Hospital of the Pontificia Universidad Católica de Chile between March 2001 and August 2013 was obtained. Data was retrieved from patients with previous RYGB that were submitted to laparoscopic or open exploration according to indications listed below, where the presence of IHWB or IHWOB was established. Written informed consent was obtained in all patients:

1. Symptomatic patients who presented with ABO after a RYGB and were submitted to laparoscopic or open surgical exploration.
2. Symptomatic patients who presented with IAP and were submitted to an elective diagnostic laparoscopic exploration after an inconclusive preoperative work-up (upper GI endoscopy, abdominopelvic iv, and orally contrast-enhanced MDCT scan and ultrasound).
3. Asymptomatic patients who were submitted to laparoscopic elective cholecystectomy due to asymptomatic cholelithiasis detected by routine postoperative ultrasound and whose mesenteric gaps were explored. Of note, Chile has one of the worldwide highest incidence of gallbladder cancer; thus, even asymptomatic patients are recommended for gallbladder resection if cholelithiasis is detected.

Data analyzed included age, sex, initial body mass index (BMI), BMI at exploration, interval between RYGB and surgical exploration, presence and type of IH, presence of

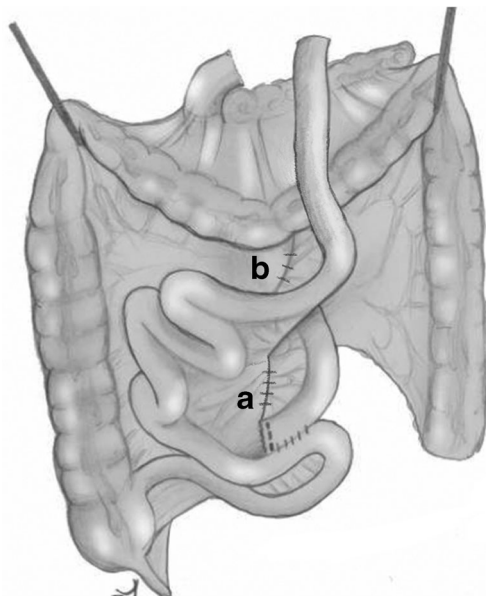


Fig. 1 Mesenteric defects created during an antecolic, antegastric Roux-en-Y gastric bypass that may lead to herniation. **a** Mesenteric defect at the jejuno-jejunostomy closed, between leaves of small bowel mesentery. **b** Petersen's space closed, between the mesentery of the alimentary limb and the mesocolon

bowel ischemia, and need of bowel resection. Also, a subgroup analysis regarding the antecolic versus retrocolic technique was performed.

LRYGB Operative Technique

In our center, LRYGB is performed as described by Higa et al. [12]. Briefly, jejunum is transected 20 to 30 cm distal to Treitz angle with minimal mesenteric transection, a 150-cm alimentary limb is created, and a stapled jejuno-jejunostomy is performed. A stapled 5-cm-high gastric pouch is performed, and a hand-sewn double-layer gastro-jejunostomy is performed. Of note, between March 2001 and December 2003, the alimentary limb was constructed and mobilized using a transmesocolic and antegastric route (retrocolic technique). In those who underwent surgery from January 2004 to August 2013, the alimentary limb was antecolic, antegastric, and right-oriented (cut end of the alimentary limb faces to patient's left and the limb to the right). In the later patients, the greater omentum was completely transected vertically to create a window to mobilize the alimentary limb.

Initially, the JYG, PS, and TMS were closed with running absorbable suture (Vicryl® 3-0, Johnson & Johnson). Since January 2003, this technique was modified and mesenteric defects were closed with 2-0 silk running sutures taking seromuscular stitches in all patients (Silk® 2-0, Johnson & Johnson; Fig. 2).

Statistical Analysis

Statistical analysis was performed using non-parametric and parametric tests, using SPSS version 21.0. Results are reported as mean \pm standard deviation and median with their ranges.

Relative risk (RR) for ABO and IH was calculated for retrocolic versus antecolic technique using chi-square test.

Results

In this period, 3,656 patients were submitted to RYGB in our institution. Of these, 2,993 (81.9 %) were performed by

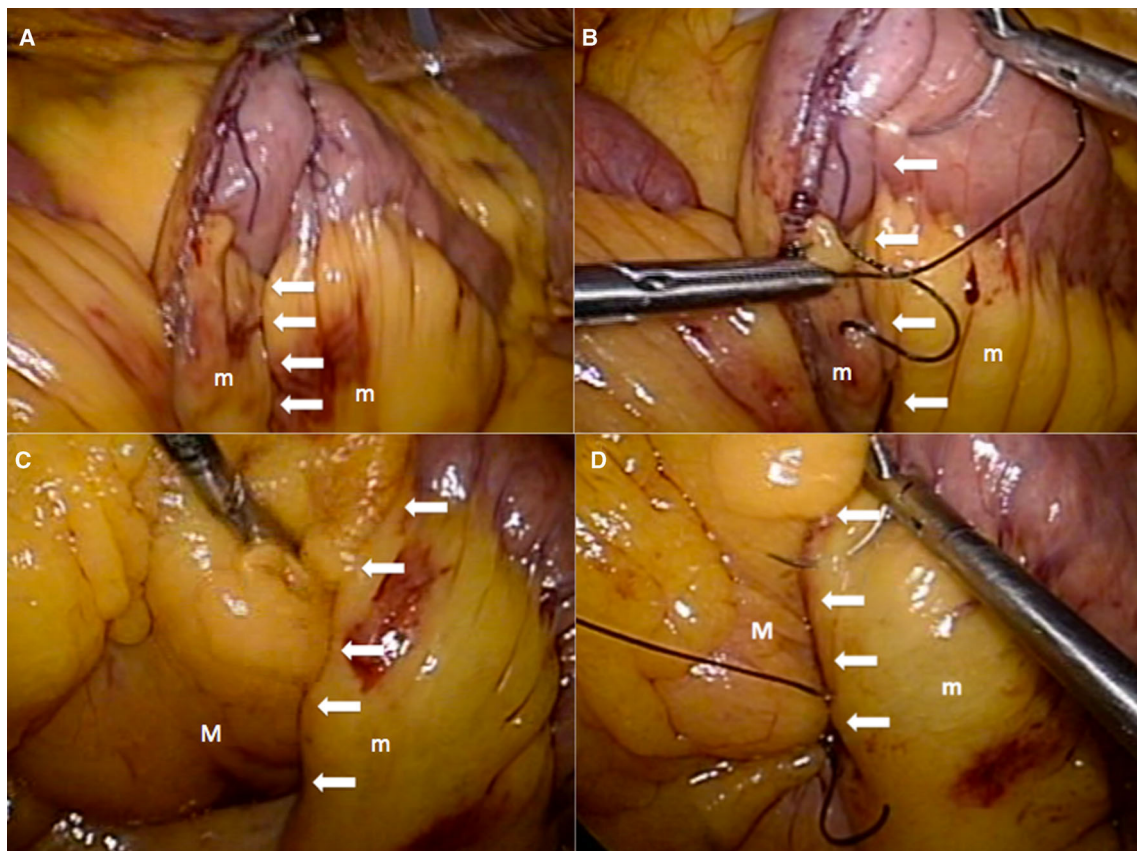


Fig. 2 Laparoscopic view of mesenteric defects created during an antecolic, antegastric Roux-en-Y gastric bypass. **a** Mesenteric defect at the jejuno-jejunostomy, between leaves of small bowel mesentery (*m*) divided. **b** Closure of jejuno-jejunostomy defect with running silk, including seromuscular stitches to the bowel. **c** Petersen's space open,

between the mesentery of the alimentary limb (*m*) and the mesocolon (*M*). **d** Closure of Petersen's space with running silk, including seromuscular stitches to the bowel (not shown). *M* mesocolon, *m* small bowel mesentery, arrows mesenteric defect

laparoscopy (since 2003). Retrocolic technique was performed in 963 patients (26.3 %, 300 patients by laparoscopy) and 2,693 patients (73.7 %) had an antecolic technique (all laparoscopic).

Complete follow-up was achieved in 2,958 patients (80.9 %) at 6 months, 1,896 patients (51.8 %) at 1 year, 1,318 patients (36.1 %) at 2 years, 426 patients (11 %) at 3 years, 232 patients (6.3 %) at 4 years, 242 patients (6.6 %) at 5 years, and 146 patients (3.9 %) at 6 years.

During follow-up, 130 patients (3.5 %) were submitted to surgical exploration due to ABO, 27 patients (0.7 %) were submitted to laparoscopic exploration due to IAP, and 93 patients (2.5 %) were submitted to laparoscopic exploration of mesenteric gaps during an elective cholecystectomy. In all patients, anatomical status of mesenteric gaps was established and recorded.

Symptomatic Patients After RYGB

Acute Bowel Obstruction After RYGB

Of the 130 patients that submitted to surgical exploration, 25 patients (19 %) had an open RYGB (3.7 % of open RYGB series) and 105 patients (81 %) had a LRYGB (3.5 % of LRYGB series). Mean age was 38.7 ± 10 years old (range 17–67) at the time of RYGB and 105 patients (81 %) were female. Mean BMI at the time of RYGB was $39.1 \text{ kg/m}^2 \pm 5.8$ (range 31–70) and at surgical exploration was $27.9 \text{ kg/m}^2 \pm 6.3$ (range 17–56). Median interval between RYGB and surgical exploration due to ABO was 13.3 months (399 days, range 1–2,471 days). Patients with open RYGB were obstructed mainly due to transmesocolic IH (18 patients) and adhesions (6 patients). The case operated in the first postoperative day was due to stricture in the closure of the TMS. Specific causes of ABO are detailed in Table 1.

In regard to alimentary limb of the RYGB, 46 patients (35 %) had a retrocolic technique (4.8 % of all retrocolic RYGB series) and 84 patients (65 %) had an antecolic technique (3.1 % of all antecolic RYGB series). Retrocolic

technique showed a higher risk of whole causes of ABO compared to antecolic technique, with a RR of 1.53 (1.07–2.17).

Full laparoscopic exploration was possible in 83 patients (64 %), 21 patients (16 %) were converted to open surgery, and 26 patients (20 %) had a primary open approach.

Of the obstructed patients, 90 of them (69 %) had an IH as the cause of ABO (IHWB); nevertheless, seven additional patients with other causes of obstruction had IHWOB, demonstrating that 97 patients had IH (75 %). In the IHWB patients, the JJG was the most common site of IH (67 patients, 52 %). Besides the higher risk of whole causes of ABO, patients with retrocolic bypass had a higher risk of IH with a RR of 1.62 (1.06–2.47) compared to that with antecolic technique. Anatomical status of all mesenteric gaps is detailed in Table 2.

Of note, there were no differences between Vicryl versus silk for closure of the mesenteric gaps in the incidence of ABO (4.3 versus 3.3 %, respectively, OR 1.3 (0.9–1.9)), IH (2.1 versus 2.2 %, respectively, OR 0.94 (0.5–1.5)), or IHWB (1.5 versus 1.9 %, respectively, OR 0.8 (0.4–1.4)) calculated in the JJG.

Twelve patients (9 %) had bowel ischemia at the exploration, six of them requiring bowel resection (5 %) due to irreversible ischemia. Of note, one patient was re-operated due to a missed jejunal perforation, requiring bowel resection with an uneventful recovery. No other complications or mortality were observed in this group.

Intermittent Abdominal Pain After RYGB

Mean age was 40.2 ± 10 years old (range 24–58), and 24 patients (89 %) were female. Mean BMI at the time of RYGB was $39.7 \text{ kg/m}^2 \pm 3.9$ (range 32–46) and at surgical exploration was $25.2 \text{ kg/m}^2 \pm 2.6$ (range 21–30). Median interval time between RYGB and surgical exploration was 20.5 months (615 days, range 210–1,596 days).

Full laparoscopic exploration was possible in 25 patients (92 %), and two patients (8 %) were converted to open surgery

Table 1 Causes of acute bowel obstruction after RYGB

Causes of acute bowel obstruction	Antecolic technique <i>N</i> =84 of 2,693 patients (3.1 %) number of patients (%)	Retrocolic technique <i>N</i> =46 of 963 patients (4.8 %) number of patients (%)
Internal hernia	57 (68)	33 (72)
Adhesions	15 (17)	10 (22)
Bezoar	7 (8)	–
Mesocolon defect stenosis	–	3 (6)
Jejuno-jejunostomy stenosis	2 (3)	–
Jejunitis	1 (1)	–
Loop of the common limb	2 (3)	–

RYGB Roux-en-Y gastric bypass

Table 2 Frequency of internal hernias and IHWB in patients with acute bowel obstruction after RYGB

	Total N=130 number of patients (%)	Antecolic technique N=84 (65 %) number of patients (%)	Retrocolic technique N=46 (35 %) number of patients (%)
Internal hernias	97 (75)	63 (75)	34 (74)
Transmesocolic	21 (16)	–	21 (46)
Petersen	29 (22)	25 (30)	4 (9)
Jejuno-jejunal	79 (61)	57 (68)	22 (48)
IHWB (obstructed secondary to IH)	90 (69)	57 (68)	33 (72)
Transmesocolic	18 (14)	–	18 (39)
Petersen	12 (9)	10 (12)	2 (4)
Jejuno-jejunal	67 (52)	50 (60)	17 (37)

RYGB Roux-en-Y gastric bypass,
IHWB internal hernia with bowel,
IH internal hernia

due to intense adhesions. Sixteen patients (59 %) had at least one IH, 4 of them (15 %) with small bowel through the gaps (IHWB). JJG was the more common site of IH (13 patients, 48 %). Surgical findings are summarized in Table 3.

Of note, no patient had bowel ischemia detected in the surgical exploration and no complications or mortality were observed in this group. Also, all patients who had IH resolved the colicky IAP after surgery.

Asymptomatic Patients After RYGB

Mean age was 34.9 ± 11 years old (range 18–67), and 75 patients (81 %) were female. Mean BMI at the time of RYGB was $39.5 \text{ kg/m}^2 \pm 4.9$ (range 36–50) and at surgical exploration was $26.7 \text{ kg/m}^2 \pm 3.6$ (range 20–35). Median interval time between RYGB and laparoscopic exploration (cholecystectomy) was 13.9 months (419 days, range 157–2,264 days). All the procedures were completed by laparoscopy. In regard to surgical findings, 23 patients (25 %) had at least one IH, but none of them had IHWB. JJG was the more common site of IH (14 patients, 15 %). Results are

Table 3 Prevalence of internal hernias and IHWB in patients with intermittent abdominal pain after RYGB

	Number of patients (%) N=27
Internal hernia	16 (59)
Transmesocolic	2 (7)
Petersen	4 (15)
Jejuno-jejunal	13 (48)
IHWB	4 (15)
Transmesocolic	0 (0)
Petersen	0 (0)
Jejuno-jejunal	4 (15)

RYGB Roux-en-Y gastric bypass, *IHWB* internal hernia with bowel

summarized in Table 4. No complications or mortality were observed in this group.

Discussion

There is extensive literature addressing the problem of IH after RYGB, with different strategies proposed in order to minimize the risk of IH such as the routine closure of mesenteric defects [13, 14], not dividing the mesentery [15], positioning the ascended alimentary limb through the antecolic way [10], division of the omentum [15], and the right orientation of the alimentary antecolic Roux limb at the gastro-jejunostomy [16]. Nevertheless, other surgical groups have also published low rates of IH, even not closing routinely the mesenteric defects, although the length of clinical follow-up is still short [15, 17, 18].

In our group, we encourage a complete exposure of the mesenteric defect before closing (Fig. 2), but it is interesting that even after closing with non-absorbable sutures like silk, IH can still develop, and even more, when RYGB patients are explored, we have noticed cases in which no suture is visible. These findings suggest that silk may not be the best option for

Table 4 Prevalence of internal hernias and IHWB in asymptomatic patients after RYGB

	Number of patients (%) N=93
Internal hernia:	23 (25)
Transmesocolic	2 (2)
Petersen	9 (10)
Jejuno-jejunal	14 (15)
IHWB	0 (0)

RYGB Roux-en-Y gastric bypass, *IHWB* internal hernia with bowel

closing the defects and other non-absorbable materials should be used instead, as proposed by some authors.

Notably, our findings reveal that even closing all mesenteric defects in the RYGB, the most common cause of postoperative ABO is still IH, and even patients obstructed for other reasons than IH, they still can have IH. When we analyzed separately antecolic versus retrocolic technique, our findings confirm that ABO and IH are more frequent in the retrocolic group, especially the transmesocolic IH accounting for almost half of the causes of ABO. Therefore, we agree to avoid this technique as many authors recommend [7, 9, 10].

Rapid weight loss and secondary reduction of mesenteric fat mass could account for opening the defects as many groups have discussed previously [4]. In addition, most of the ABO secondary to IH occurs in the first 2 years after a RYGB, coinciding with a period of maximum excess weight lost (EWL). In our series, all patients were explored between the first and second postoperative year, coinciding with their higher EWL and BMI loss. Also, our results showed that obstructed patients required surgery about 7 months earlier than patients with IAP (13.3 versus 20.5 months). Unfortunately, we were not able to determine how long the patients were presenting with IAP; thus, it is possible that these patients that presented with symptoms at the same time of obstructed patients, but just by random, did not developed an incarceration. In fact, Paroz et al. reported in their IH series that patients operated due to ABO had recurrent abdominal pain before the obstruction episode [19].

One of the most important observations of our study is that the non-obstructed patients, such as those symptomatic because of colicky IAP and normal preoperative work-up, showed a high rate of IH (59 %), and even more, 15 % of those patients had IHWB but not obstructed. Quite different results have been reported in this subset of patients; Paroz et al. reported that 11 out of 12 patients had IH when symptomatic patients were explored [19]. In contrast to these findings, Madan et al. reported that 2 out of 50 patients had IH [17]. In our experience and in agreement with our results, we think that intermittent colicky abdominal pain after a RYGB (even with a normal preoperative work-up) should reduce the threshold to surgically explore in an elective setting.

Finally, we found that 25 % of asymptomatic patients who were explored had IH, suggesting that whatever the reason a patient after RYGB is explored, mesenteric gaps must be actively explored and closed.

Limitations of our study include that this is a retrospective analysis of a large series of RYGB with variations over time as antecolic placement of the alimentary limb, use of laparoscopy, and changes in type of suture used to close the mesenteric defects. We also have to note that the decision of exploring a

symptomatic non-obstructed patient was absolutely dependent on the surgeon's judgment, and no protocol was followed; thus, there is a chance to under diagnose this problem, especially in IAP and asymptomatic patients. Finally, our follow-up is limited, and some patients could have been explored in other centers, not diagnosed or not reported. For example, in the case of asymptomatic patients, it has been reported that up to 15 % of patients can develop cholelithiasis following bariatric surgery; thus, we should have more explorations for IH in cholecystectomies and not the 2.5 % reported here.

In conclusion, a high frequency of IH exists in all operated patients of this series. All members of the bariatric team should be aware of the symptoms related to IH and actively pursue it during follow-up.

Conflicts of Interest Disclosure Statement Drs. Nicolás Quezada, Felipe León, Alex Jones, Julián Varas, Ricardo Funke, Fernando Crovari, Alejandro Raddatz, Gustavo Pérez, Alex Escalona, and Camilo Boza have no conflicts of interest or financial ties to disclose.

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