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Three-Year Follow-Up Study of Retrocolic versus Antecolic Laparoscopic Roux-en-Y Gastric Bypass

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Background: Since 1994, laparoscopic Roux-en-Y gastric bypass (LRYGBP) has gained popularity for the treatment of morbid obesity. In analogy to open surgery, the operation was initially performed in a retrocolic fashion. Later, an antecolic procedure was introduced. According to short-term studies, the antecolic technique is favorable. In this study, we compared the retrocolic vs the antecolic technique with 3 years of follow-up. We hypothesized that the antecolic technique is superior to the retrocolic in terms of operation time and morbidity.

Methods: 33 consecutive patients with retrocolic technique and 33 patients with antecolic technique of LRYGBP were compared, using a matched-pair analysis. Data were extracted from a prospectively collected database. The matching criteria were: BMI, age, gender and type of bypass (proximal or distal). The end-points of the study were: operation time, length of hospital stay, incidence of early and late complications, reoperation rates and weight loss in the follow-up over 36 months.

Results: In the retrocolic group, operation time was 219 min compared to 188 min in the antecolic group (*P*=0.036). In the retrocolic group, 3 patients (9.1%) developed an internal hernia and 4 patients (12.1%) suffered from anastomotic strictures. In the antecolic group, 2 patients (6.1%) developed internal hernias and in 3 patients (9.1%) anastomotic strictures occurred. Median hospital stay in the retrocolic group was 8 days compared to 7 days in the antecolic group. In the antecolic group, the mean BMI dropped from 46 kg/m^2 to 32 kg/m^2 postoperatively after 36 months. This corresponds to an excess BMI loss of 66%. In the retrocolic group, we found a similar decrease in BMI from preoperative 45 kg/m^2 to 34 kg/m^2 after 36 months (*P*=0.276).

Conclusion: The results of our study demonstrate a reduction of operation time and hospital stay in the antecolic group compared to the retrocolic group. No differences between the two groups were found regarding morbidity and weight loss. Taken together, the antecolic seems to be superior to the retrocolic technique.

Key words: Morbid obesity, bariatric surgery, laparoscopic Roux-en-Y gastric bypass, technique, internal hernia

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Introduction

Roux-en-Y gastric bypass (RYGBP) is the most common operation for morbid obesity in the United States.[1,2] The different surgical techniques for RYGBP are still under intense discussion.

Several randomized controlled trials have confirmed the advantages of the laparoscopic approach.[3-5] Since its introduction in 1994, laparoscopic RYGBP has rapidly gained popularity,[6] and the majority of surgeons have adopted this technique.[7] In a review of 18 studies comparing laparoscopic with open RYGBP between 1994 and 2002, Podnos et al[8] showed a significant decrease of iatrogenic splenectomy, wound infection, incisional hernias, and mortality with the laparoscopic approach. However, there was an increased incidence of anastomotic strictures and of bowel obstruction as a result of internal hernias.[8,9]

One area of continued debate is the orientation of the Roux or alimentary limb, i.e. retrocolic (RC) versus antecolic (AC). Analogous to the open surgery, the operation was initially performed in a retrocolic fashion. The antecolic technique was introduced later, and was considered to be technically easier and

resulting in less complications.[10,11] Which of these technical modalities is superior from a long-term perspective is unknown, because comparative data are lacking. Several cohort studies describe the different approaches, but only short-term outcome has been reported.[8,12,13]

Our study compares the outcome of both technical modalities over a 3-year period. Both groups were compared by a matched-pair study design, analyzing a large prospectively-collected database. We hypothesized that the antecolic technique is superior to the retrocolic in terms of operative time and morbidity, but we did not expect a difference in postoperative weight loss.

Patients and Methods

A total of 33 consecutive patients with a retrocolic laparoscopic RYGBP were compared to 33 patients with an antecolic approach, using a matched-pair method. The operations were performed between July 2000 and November 2002. Both proximal (alimentary limb of 150 cm) and distal (common channel of 150 cm) bypass procedures were performed. At the beginning, only the retrocolic technique was used. Later, the technique was switched to the antecolic procedure, as a consequence of the unsatisfying results reported in the literature regarding the retrocolic approach.[14] The data were extracted from a prospectively-collected database of all patients (n>500) undergoing bariatric surgery at the Department of Visceral and Transplantation Surgery at the University Hospital Zurich. The patients were matched according to age, gender, body mass index (BMI) and type of bypass (proximal or distal). The end-points of the study over a follow-up of 36 months were operative time, length of hospital stay, postoperative BMI as well as excess BMI loss (EBL), and complication rates with special emphasis on internal hernias.

Surgical Technique

All bypass procedures were performed laparoscopically as described by Wittgrove in 1994.[6] Briefly, a small gastric pouch of 15-25 ml is created. Next, the jejunum is transected 50 cm distal to the duodeno-jejunal flexure, and the jejuno-jejunostomy is performed using a linear stapler. The mesenteric window at the jejuno-jejunostomy is closed with one or two single stitches using a non-absorbable suture (Ethibond™). Either an alimentary limb length of 150 cm in the proximal bypass or a common channel of 150 cm in the distal bypass is chosen, depending on the preoperative BMI. The alimentary limb is then brought up to the gastric pouch. The gastro-jejunal anastomosis is performed with a circular stapling device (CEEA 25-mm, Tyco, Mansfield, MA), which is inserted transabdominally. In the antecolic technique, the alimentary limb is brought up directly to the pouch, whereas in the retrocolic approach, the Roux limb is passed through a mesocolic window. The mesocolic window and the Petersen's defect were not closed with sutures.

Statistical Analysis

The statistical analysis was performed using standard software SPSS 12.0 for Windows (SPSS, Chicago, IL, USA). Our null hypothesis was that there was no difference between the two groups; the null hypothesis was rejected at a level of $\alpha<0.05$. The Mann-Whitney-U test was used to compare continuous variables between the two groups. Categorical variables were compared using the χ^2 test, or when appropriate, Fischer's exact test was applied. Results are expressed as mean and standard deviation (SD), unless otherwise stated. A *P*-value <0.05 was considered to indicate statistical significance.

Results

According to the matching criteria, the patients were comparable regarding age, gender, BMI, and proximal or distal gastric bypass. The two groups consisted of 25 female and 8 male patients each. The mean age in the retrocolic-treated patients was 41 years (range 26-59) and in the antecolic-operated group was 42 years (range 24-60). Preoperatively, the average BMI in the retrocolic group was 45.0 kg/m^2 (range 34.6-64.6) and in the antecolic group was 45.7 kg/m^2 (range 35.6-65.9). The characteristics of the patients are presented in Table 1.

Table 1. Patient Characteristics

	Antecolic (n=33)	Retrocolic (n=33)
Age (y) (SD)	42.0 (9.8)	41.3 (9.7)
range	24-60	26-59
Gender (f/m)	25/ 8	25/ 8
BMI (kg/m^2) (SD)	45.7 (6.0)	45.0 (6.2)
range	35.6-65.9	34.6-64.6
Bypass type		
alimentary 150 cm (proximal)	24	24
common channel 150 cm (distal)	9	9

The average operation time in the retrocolic group was 219 minutes compared to 188 minutes in the antecolic group (P=0.036). Postoperative complications occurred in 21% (n=7) of the patients in the retrocolic group and in 15% (n=5) in the antecolic group, respectively (P=0.751). Internal hernias (3 vs 2) and anastomotic strictures (4 vs 3) were not significantly different between the two groups. In contrast, the median length of hospital stay was shorter in the antecolic bypass group in comparison to the retrocolic bypass group (7 vs 8 days, P=0.013). The results are summarized in Table 2.

Table 2. Results

	Antecolic	Retrocolic	*P*
Operation time (min)	188 (SD 48.8)	219 (SD 57.4)	0.036
Conversion to open (n)	1	2	1
Length of stay (median, d)*	7	8	0.013
range	4-24	4-43	
Overall complications n (%)	5 (15)	7 (21)	0.751
Internal hernia (n)	2	3	
Anastomotic stricture (n)	3	4	
Death (n)	0	0	

*In the Swiss system, we do not have same-day admissions, and patients are discharged home (and not to an affiliated institution), when oral intake is sufficient and patients can take care of themselves alone including self-administration of low molecular weight heparin SC. This accounts for longer length of stay than in the USA.

Interestingly, almost all internal hernias occurred in the mesenteric window of the jejuno-jejunostomy (Table 3). They became symptomatic late in the follow-up, and after a significant weight loss of usually >10 BMI points. In contrast, the single transmescolic hernia already became symptomatic 2 weeks after the operation. The hernias were diagnosed laparoscopically and were repositioned after conversion to open surgery. In only one case, the reposition could be achieved by laparoscopy. The mesenteric window was always closed with sutures. In one case, the small bowel was partially incarcerated and had to be resected. The relation between BMI and time of occurrence of internal hernia is shown in Figure 1.

The follow-up rate was 88% after 3 years, and the mean length of follow-up was 34.5 months. The weight loss in the two groups was comparable and is shown in Figure 2.

Discussion

Two technical modalities in LRYGBP are the retrocolic and antecolic positioning of the Roux limb. The technical challenge of a retrocolic Roux-limb positioning is undisputed. The transposition through the mesocolic window in a more or less blind fashion, and the poorer tactile properties of the laparoscopic instruments lead to a more challenging procedure compared to open surgery. In contrast, the antecolic positioning allows visual control of the Roux-limb orientation and its integrity. In order to compare these two different techniques, we chose a matched-pair analysis and established two homogeneous patient groups according to the matching criteria. The analysis of our 3-year results now demonstrates that the more time-consuming and technically-challenging retrocolic procedure has no advantage over the antecolic Roux-limb positioning in terms of weight loss and late complications. The higher complexity of the retrocolic positioning is mirrored in the longer operative time in our study.

A specific problem of LRYGBP operations is the occurrence of internal hernias. This finding might be explained in part by the more difficult exposure of the small bowel and the related mesentery, as well as the more complex suturing of the laparoscopic approach.[8,9] Typical localizations of hernias after

Table 3. Types of internal hernias

Patient	Type	Internal hernia	Time (m)	BMI loss	Consequence
1	RC	distal anastomosis	26	14	conv & reposition
2	RC	transmesocolic	<1	1	conv & reposition
3	RC	distal anastomosis	4	10	open reposition
4	AC	distal anastomosis	9	13	lap & reposition
5	AC	distal anastomosis	8	14	conv & resection

RC: retrocolic, AC: antecolic, conv: conversion from laparoscopy to open surgery, lap: laparoscopy.

LRYGBP are the mesenteric window of the distal jejuno-jejunostomy and the window behind the mesentery of the Roux-limb (Petersen's hernia). The retrocolic Roux-limb positioning has an additional possibility for a herniation of the small bowel through the mesocolic window. This is one reason why the retrocolic RYGBP has a higher rate of internal hernias in the literature.[10] Although rare, internal herniation can cause massive bowel infarction and bowel perforation; therefore, timely recognition and a low threshold for operation is crucial.[12-14]

In our study, we could not demonstrate a difference in incidence of internal hernias in the two groups, probably due to the small sample size. A comparison of occurrence at the mesocolic window was not possible because the event was rare (n=1). Surprisingly, our rate of internal hernias was relatively high (7.5%) compared to other studies, which report internal hernia rates between 1.5 % and 3.1%.[8,10,12,13] This might be due to the consistent high follow-up rate and the longer period of observation in our study. In most other studies, internal hernias are described after 21[10] or 150 days.[13] Additionally, in our institution, the patients after LRYGBP are brought back to surgery with a low threshold for a diagnostic laparoscopy in the case of unexplained abdominal pain, because internal hernias are very difficult to detect. To date, no consistent clinical signs or diagnostic tests exist that can confirm or rule out an internal hernia with adequate reliability. A contrast follow through can be falsely negative in a high rate.[8] Abdominal CT scan with oral contrast has the potential to diagnose an internal hernia, but this examination is not sensitive enough to be routinely recommended.[12]

When performing laparoscopy, we recommend starting the exploration from the ileocecal valve, working the way along the small bowel proximally. The common channel, which is herniated in the majority of cases, is reduced gradually this way. In our experience, it can be more difficult to reduce the hernia if one starts at the alimentary Roux limb. After the reduction of the hernia, the mesenteric defect can be closed laparoscopically. If the reduction is not possible or if small bowel has to be resected, conversion to open surgery is recommended.

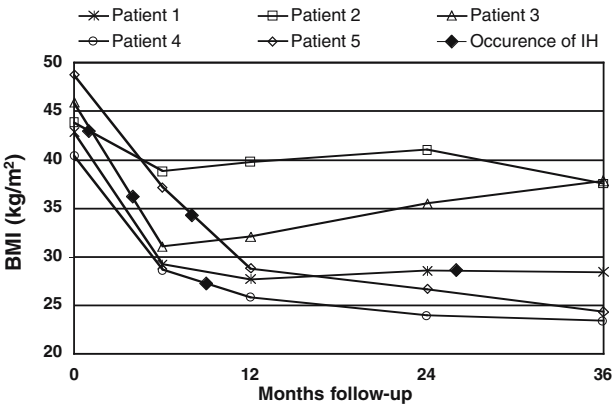

Figure 1. Relationship between the occurrence of an internal hernia (IH) and the BMI and/or the time of occurrence.

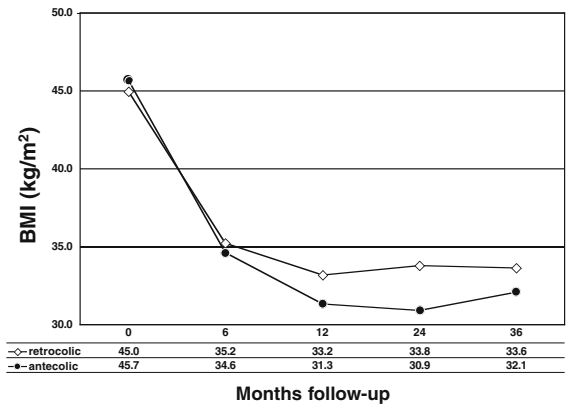

Figure 2. The decrease of body mass index (BMI) points was comparable in both procedures during follow-up (*P*=0.276).

One reason for the emergence of internal hernias is the incomplete closure of the mesenteric defect at the first operation.[9] In our technique, the mesentery at the jejuno-jejunostomy was split only 2-3 cm and routinely closed with one or two non-absorbable sutures. Interestingly, the majority of internal hernias in this study occurred after a significant weight loss. This fact suggests that weight loss leads to an increase in existing small mesenteric defects due to slimming of the mesentery. In addition, we believe that a slender mesentery results in a higher mobility of the small bowel, which might further enhance the risk of herniation.

Internal hernias occurred as late as 2 years after RYGBP indicating that the risk for this complication might remain during the rest of life. The cumulative incidence of internal hernias might therefore be much higher than reported in the literature or communicated to patients.

Whether the higher tension on the antecolic Roux limb leads to a higher rate of strictures is discussed controversially.[15] We could not find a difference, although the small sample size and the relatively rare event do not allow statistical analysis. Other factors like the use of reinforcement sutures and the size of the circular stapler are believed to be more important factors for the development of a stricture.[15]

According to our results, we conclude that the antecolic Roux limb positioning is easier, faster and equally effective and safe in the long-term, compared to the retrocolic method. Therefore, the antecolic approach represents the better alternative in laparoscopic gastric bypass surgery.

References

1. Sauerland S, Angrisani L, Belachew M et al. Obesity surgery: Evidence-based guidelines of the European Association for Endoscopic Surgery (EAES). Surg Endosc 2005; 19: 200-21.
2. Buchwald H, Avidor Y, Braunwald E et al. Bariatric surgery: a systematic review and meta-analysis. JAMA 2004; 292: 1724-37.
3. Lujan JA, Frutos MD, Hernandez Q et al. Laparoscopic versus open gastric bypass in the treatment of morbid obesity: a randomized prospective study. Ann Surg 2004; 239: 433-7.
4. Nguyen NT, Goldman C, Rosenquist CJ et al. Laparoscopic versus open gastric bypass: a randomized study of outcomes, quality of life, and costs. Ann Surg 2001; 234:279-89; discussion 289-91.
5. Westling A, Gustavsson S. Laparoscopic vs open Roux-en-Y gastric bypass: a prospective, randomized trial. Obes Surg 2001; 11: 284-92.
6. Wittgrove AC, Clark GW, Tremblay LJ. Laparoscopic gastric bypass, Roux-en-Y: Preliminary report of five cases. Obes Surg 1994; 4: 353-7.
7. Jones DB, Provost DA, DeMaria EJ et al. Optimal management of the morbidly obese patient SAGES appropriateness conference statement. Surg Endosc 2004; 18: 1029-37.
8. Podnos YD, Jimenez JC, Wilson SE et al. Complications after laparoscopic gastric bypass: a review of 3464 cases. Arch Surg 2003; 138: 957-61.
9. Higa KD, Ho T, Boone KB. Internal hernias after laparoscopic Roux-en-Y gastric bypass: incidence, treatment and prevention. Obes Surg 2003; 13: 350-4.
10. Champion JK, Williams M. Small bowel obstruction and internal hernias after laparoscopic Roux-en-Y gastric bypass. Obes Surg 2003; 13: 596-600.
11. Schauer PR, Ikramuddin S, Hamad G et al. Laparoscopic gastric bypass surgery: current technique. J Laparoendosc Adv Surg Tech A 2003; 13: 229-39.
12. Cho M, Carrodeguas L, Pinto D et al. Diagnosis and management of partial small bowel obstruction after laparoscopic antecolic antegastric Roux-en-Y gastric bypass for morbid obesity. J Am Coll Surg 2006; 202: 262-8.
13. Eckhauser A, Torquati A, Youssef Y et al. Internal hernia: postoperative complication of roux-en-Y gastric bypass surgery. Am Surg 2006; 72:581-4; discussion 584-5.
14. Serra C, Baltasar A, Bou R et al. Internal hernias and gastric perforation after a laparoscopic gastric bypass. Obes Surg 1999; 9: 546-9.
15. Nguyen NT, Stevens CM, Wolfe BM. Incidence and outcome of anastomotic stricture after laparoscopic gastric bypass. J Gastrointest Surg 2003; 7: 997-1003; discussion 1003.

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