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Original article

The effect of routine division of the greater omentum on small bowel obstruction after Roux-en-Y gastric bypass

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Abstract

Background: It remains unknown whether routine division of the greater omentum during laparoscopic Roux-en-Y gastric bypass (LRYGB) influences the risk for small bowel obstruction (SBO) after RYGB.

Objective: To evaluate the effect of omental division on SBO after LRYGB stratified by handling of the mesenteric defects.

Setting: Nationwide, registry-based.

Methods: In this registry-based cohort study, 40,517 patients who underwent LRYGB in Sweden within the period from January 1, 2007, to December 31, 2019, with data from the Scandinavian Obesity Surgery Registry (SOReg) were included. The study was based on combined data from the SOReg, the National Patient Register, the Swedish Prescribed Drugs Register, and the Total Population Registry. The main outcome was reoperation for SBO.

Results: During a follow-up period of 5.9 ± 2.6 years, the cumulative incidence of SBO was 11.2% in the nondivision group compared with 9.7% among patients with divided omentum (hazard ratio [HR] = .83, 95% confidence interval [CI]: .77–.89, $P < .001$). The association was seen in patients without mesenteric defects closure (HR = .69, 95% CI: .61–.78, $P < .001$) as well as patients with closed mesenteric defects (HR = .80, 95% CI: .74–.87, $P < .001$).

Conclusion: Division of the greater omentum is associated with reduced risk for SBO after antecolic, antegastric LRYGB and should be considered as a complement to mesenteric defects closure to further reduce the risk for SBO after LRYGB. (Surg Obes Relat Dis 2023;19:178–186.)

Keywords: Obesity; Bariatric surgery; Postoperative complication; Small bowel obstruction; Omentum

Despite the effectiveness of the Roux-en-Y gastric bypass (RYGB) for treatment of severe obesity, there is a general concern over long-term risks and side-effects [1–3]. One of the major long-term complications is internal herniation and small bowel obstruction (SBO), with a reported long-term risk of 10% to 16% [4,5]. While routine closure of the mesenteric defects has been associated with a marked reduction in this risk, it does not completely eliminate it. A more recent nationwide observational study reported a reduction in risk for SBO from 11% to 7% with mesenteric defects closure [6]. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is known to cause few adhesions and a significant postoperative weight-loss, both of which are associated with an increased risk for internal herniation [7–9].

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Division of the greater omentum was originally suggested to reduce tension on the gastrojejunostomy [10]. In an antecolic LRYGB, the alimentary limb passes in between the divided omental sheets and thereby partly cover Petersen's space. To the best of our knowledge, there is a paucity in studies addressing the safety and efficacy of routine omental division in LRYGB. Therefore, the aim of this study was to evaluate the safety and efficacy of omental division during LRYGB with stratification by mesenteric defects closure.

Methods

This study is a nationwide, multicenter study including all adults (≥18 years) with a body mass index (BMI) ≥30 kg/m^2 who underwent a primary LRYGB in Sweden between 2007 and 2019. Missing data on omental division and handling of mesenteric defects were considered criteria for exclusion.

The study group was identified from the Scandinavian Obesity Surgery Registry (SOReg), a national research and quality registry introduced in 2007 that currently covers virtually all bariatric surgical procedures in Sweden [11]. The registry is continuously validated and has so far been shown to have a high validity of data [12]. The national personal identification numbers (unique to all Swedish citizens) were used to link the SOReg database to the National Patient Registry, which covers in-hospital and outpatient care at specialized care and emergency departments [13], and to the Total Population Registry (with complete coverage of mortality and emigration) [14].

The surgical technique for LRYGB is standard throughout Sweden, with 99% being the antecolic, antegastric laparoscopic gastric bypass procedure, often referred to as the Lönroth technique [10,15]. Before 2010, mesenteric defects were not routinely closed. During 2010 to 2011 a randomized controlled trial regarding closure of mesenteric defects was performed in Sweden. The results of this study led to the 2016 decision to make closure of mesenteric defects a routine part of LRYGB in Sweden [7].

Definitions

Co-morbidities were specified as specific obesity-related co-morbid diseases requiring pharmacologic treatment or nocturnal continuous positive airway pressure treatment.

Outcomes

The primary outcome was reoperation for SBO. This was based on combined data from SOReg and the National Patient registry and was defined as a specified reoperation for SBO in SOReg or a diagnosis of SBO in the National Patient registry with a relevant abdominal operation. Secondary endpoints were perioperative complications, early postoperative complications (within 30 days after surgery), and serious early postoperative complications. The intraoperative complications were specified as intraoperative bleeding, unintentional bowel perforation, and other specified complication. Specific postoperative complications were postoperative bleeding, leakage or intraabdominal abscesses, wound complications, SBO or anastomotic stricture, marginal ulcer, cardiovascular event, pulmonary event, deep venous thrombosis or pulmonary embolism, urinary tract infection, nutritional deficiency, abdominal pain and other (specified) complication. The Clavien-Dindo classification for postoperative complications was introduced in 2010, with complications defined as grade IIIb or higher considered to be serious postoperative complications (i.e., complications requiring intervention under general anesthesia, resulting in organ failure or death) [16].

Statistics

Continuous variables are presented as mean and standard deviation and categorical variables as numbers and proportions. The t test was used to compare continuous variables, and the χ^2 test for categorical variables. Patients were followed until reoperation for SBO, emigration, and death for 9 years or until December 31, 2019, whichever came first. The Kaplan-Meier test was used to visualize and estimate cumulative risk for SBO, with risk evaluation using Cox proportional hazard regression. Based on known previously described risk factors for SBO after LRYGB, the model was also stratified for mesenteric defects closure and adjusted for age, sex, BMI, and year of surgery. The secondary endpoints were evaluated using logistic regression, adjusted for age, sex, BMI, obesity-related co-morbidities, mesenteric defects closure, and year of surgery. Missing data were handled by listwise deletion. A $P < .05$ was considered to represent a statistically significant difference. All statistical analyses were conducted using SPSS Statistics version 28 (IBM, Armonk, NY, USA) and R version 4.0.0 (R Core Team, Vienna, Austria).

Ethics

The study was approved by the Swedish Ethical Review Authority (Ref: 2020-03005).

Results

A total of 55,846 operated with antecolic, antegastric LRYGB in Sweden during the study period were identified. Data on omental division were available for 40,720 patients. After exclusion of 203 patients with unknown handling of the mesenteric defects, 40,517 patients remained within the study (Fig 1). The omentum was divided in 20,532 patients (50.7%), and 19,985 patients did not have their omentum divided during surgery (49.3%). During follow-up, 195 patients emigrated (.9%) and 408 died (2.0%) in the omental division group, and 189 patients emigrated (.9%), and 267

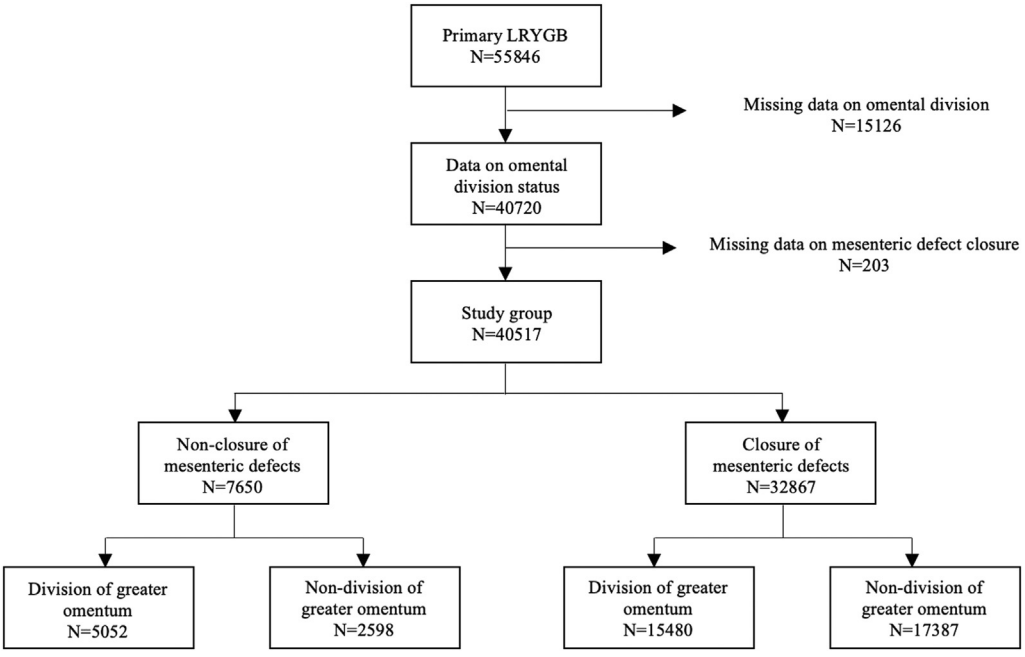

Fig. 1. Study flowchart describing enrollment and inclusion.

died (1.3%) in the nonomental division group, resulting in a mean follow up time of 5.7 (3.2–7.3) years in the omental division group, and 6.2 (3.32–8.18) years in the nonomental division group. Patients in the omental division group were older, more often men, and had higher rates of metabolic co-morbidities compared with the nondivision group. They were also less likely to have their mesenteric defects closed during the operation (Table 1).

Perioperative outcome

During the operation, 659 patients with omental division (3.2%; adjusted odds ratio [OR] = 1.60, 95% confidence interval [CI]: 1.40–1.83; $P < .001$) experienced an intraoperative adverse event compared to 355 patients without omental division (1.8%; Table 2).

Follow-up data at Day 30 were available for 39,202 patients (97%). A postoperative complication occurred for 1679 patients in the omental division group (8.4%), and 1541 patients in the nonomental division group (8.0%). A serious postoperative complication occurred for 643 patients in the omental division group (3.2%), and 641 patients in the nonomental division group (3.3%; Table 2).

Small bowel obstruction

The absolute number of patients reoperated for SBO was 1559 in the omental division group (cumulative incidence =

Table 1
Baseline characteristics

Variable	Total (n = 40,517)	Omental division (n = 20,532)	No omental division (n = 19,985)	*P* value*
Age at time of operation (yr)	40.9 (11.3)	41.9 (11.3)	39.8 (11.3)	**<.001**
Sex				
Male	9945 (24.5)	5934 (28.9)	4011 (20.1)	**<.001**
Female	30,572 (75.5)	14,598 (71.1)	15,974 (79.9)	
Body mass index, kg/m^2	42.1 (5.3)	42.5 (5.5)	41.6 (5.1)	**<.001**
Co-morbidities				
Diabetes	5985 (14.8)	3492 (17)	2493 (12.5)	**<.001**
Hypertension	10,750 (26.5)	6200 (30.2)	4550 (22.8)	**<.001**
Dyslipidemia	4262 (10.5)	2529 (12.3)	1733 (8.7)	**<.001**
Sleep apnea	4510 (11.1)	2703 (13.2)	1807 (9)	**<.001**
Depression	6417 (15.8)	3185 (15.5)	3232 (16.2)	.069
Closed mesenterial defects	32,867 (81.1)	15,480 (75.4)	17,387 (87)	**<.001**

Data are presented as n (%) or mean ± standard definition. Values in boldface are statistically significant.
* *P* value for continuous values from independent samples *t* test and for categorical values from χ^2 test.

Table 2
Perioperative adverse events up until 30 days after surgery

Adverse event	Omental division (n = 20,532)	Nonomental division (n = 19,985)	Adjusted odds ratio (95% confidence interval)	*P* value
Intraoperative complication	659 (3.2)	355 (1.8)	1.60 (1.40–1.83)	**<.001**
Bleeding	142 (.7)	77 (.4)	1.58 (1.19–2.11)	**.002**
Unintentional bowel injury	362 (1.8)	170 (.9)	1.82 (1.51–2.20)	**<.001**
Other	170 (.8)	106 (.5)	1.33 (1.03–1.70)	**.027**
Postoperative complication*	1679 (8.4)	1541 (8)	1.03 (.96–1.11)	.401
Postoperative bleeding	394 (2.0)	326 (2.0)	1.04 (.89–1.21)	.626
Anastomotic leakage/deep intrabdominal abscess	322 (1.6)	275 (1.4)	1.00 (.84–1.18)	.966
Wound complication	260 (1.3)	162 (0.8)	1.37 (1.12–1.68)	**.002**
Small bowel obstruction/stricture	267 (1.3)	322 (1.7)	.85 (.72–1.00)	.053
Marginal ulcer	97 (.5)	87 (.5)	1.08 (.80–1.45)	.633
Cardiovascular complication	30 (.2)	25 (.1)	.90 (.52–1.56)	.706
Pulmonary complication	124 (.6)	93 (.5)	1.15 (.87–1.52)	.314
Venous thrombosis	16 (.1)	19 (.1)	.73 (.36–1.44)	.360
Urinary tract infection	92 (.5)	55 (.3)	1.50 (1.06–2.11)	**.021**
Nutritional deficiency	83 (.4)	104 (.5)	.89 (.66–1.20)	.456
Abdominal pain	194 (1.0)	208 (1.1)	1.07 (.87–1.30)	.526
Other	171 (.9)	149 (.8)	1.12 (.89–1.40)	.330
Readmission within 30 d†	1700 (8.5)	1713 (8.9)	.95 (.88–1.02)	.949
Serious complication‡	643 (3.2)	641 (3.3)	.97 (.87–1.09)	.636

Data are presented as n (%). Values in boldface are statistically significant.
* Data on postoperative complications 6 weeks after surgery were available for 39,202 patients.
† Missing data for 40 patients (.2%) with omental division, and 192 patients (1.0%) with no omental division.
‡ Serious complications are defined as ≥IIIb according to the Clavien-Dindo classification for surgical complications. Data on follow-up for serious complications were available from 2010 for 38,741 patients.

9.7%; hazard ratio [HR] = .83; 95% CI: .77–89; $P < .001$), and 1764 in the nonomental division group (cumulative incidence = 11.2%). When stratified by mesenteric defects closure, a risk reduction was seen among patients who did not have their mesenteric defects closed (HR = .68; 95% CI: .60–.77; $P < .001$; adjusted HR = .73, 95% CI: .64–.83, $P < .001$) as well as when the mesenteric defects were closed (HR = .80; 95% CI: .74–.87; $P < .001$; adjusted HR = .87; 95% CI: .80–.95, $P = .001$) (Fig. 2A, 2B). The main difference was related to internal herniation (Table 3).

Discussion

Routine division of the greater omentum during LRYGB was associated with a lower risk for SBO than if the greater

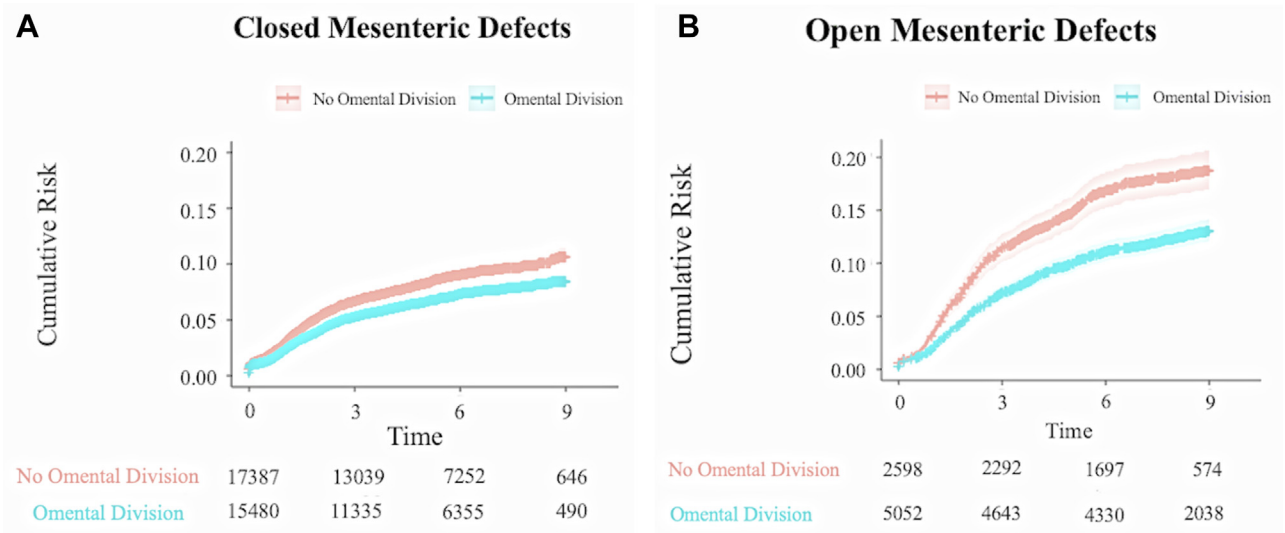

Fig. 2. Difference in cumulative incidence of small bowel obstruction between patients with and without omental division among patients with closed mesenteric defects (A) and open mesenteric defects (B).

Table 3
Causes of small bowel obstruction

Cause	Mesenteric defects unclosed		Mesenteric defects closed	
	Omental division	Nonomental division	Omental division	Nonomental division
No small bowel obstruction	4451 (88.6)	2184 (84.9)	14520 (93.8)	16035 (92.2)
Kinking/narrowing Jejunojejunostomy	13 (.3)	12 (.5)	79 (.5)	138 (.8)
Adhesions	49 (1.0)	25 (1.0)	162 (1.0)	182 (1.0)
Internal hernia	343 (6.8)	270 (10.4)	387 (2.5)	658 (3.8)
Invagination	21 (.4)	10 (.4)	42 (.3)	48 (.3)
Multiple causes	4 (.1)	5 (.2)	5 (0)	14 (.1)
Incisional hernia	2 (0)	0 (0)	4 (0)	2 (0)
Other/unknown	169 (3.3)	92 (3.5)	281 (1.8)	310 (1.8)

Data are presented as n (%).

omentum was not divided. A reduced risk was seen both when the mesenteric defects were closed and when they were left open.

However, division of the omentum was associated with greater risk for intraoperative adverse events compared to patients for whom the omentum was not divided. An increased risk of intraoperative bleeding, bowel injury, as well as other complications, was seen. This difference could be explained in part by the higher proportion of men and higher BMI, with associated intra-abdominal fat mass and technically more challenging procedures, in the omental division group. The anatomically close location of the greater omentum to the transverse colon may explain, at least in part, the increased risk of unintentional bowel injury. Furthermore, dividing the vascularized tissue of the omentum may cause smaller bleedings. However, while intraoperative adverse events are known to increase the risk for postoperative complications [17,18], these intraoperative adverse events are by nature often addressed during the operation and no increase in postoperative complication rates was seen. The results of the present study support the results of a previous study reporting that division of the omentum can be considered to be both feasible and safe during LRYGB [19].

Closure of the mesenteric defects is known to reduce the risk of internal hernia during LRYGB [7,8,20–22]. In this study as well, closure of the mesenteric defects was also seen to be the most important intervention to reduce the risk for SBO. Division of the omentum had an additive effect in reducing the risk for SBO in patients without mesenteric defects closure, but also for patients for whom the mesenteric defects were closed. The main cause of this risk reduction appears to be a reduction of internal herniation. While we were not able to separate the site of internal herniation in the present study, the division of the omentum will result in the 2 omental blades partially covering Petersen's space which is the location most likely to cause this risk reduction. Petersen's space is by many considered the mesenteric defect most difficult to close. A general strengthening of the defect from the omental sheets, in particular for patients where Petersen's space are less optimally closed, is the possible explanation to why the risk was reduced also for patients with primary closure of the mesenteric defects. This theory is also supported by the results of a recent single center study, reporting low rates of internal herniation thorough Petersen's space after splitting the omentum [23].

While the routine closure of mesenteric defects during LRYGB has dramatically reduced the incidence of internal herniation with SBO, this complication still occurs [7,8]. The complication can be difficult to diagnose and may result in serious outcomes [24–26]. In addition, the risk for internal herniation appears to be increased during pregnancy [27], a condition complicating diagnosis and treatment even further with potentially devastating consequences for mother and infant [28]. Any intervention resulting in further reduction of the risk for this complication is therefore of value. Routine division of the omentum is a simple and reasonably safe intervention associated with reduced incidence of SBO with results that should be valid for patients undergoing antecolic, antegastric LRYGB.

This study benefits from the large cohort of patients, with a nationwide inclusion with high quality data from the national registries for bariatric surgery and specialized care. However, the study is not without limitations. Given the observational study design we cannot evaluate causation. Preferably, a randomized clinical trial should be conducted to ensure the validity of these results. Given the necessary size of such a trial we find it unlikely that such a trial will be conducted and any guidance will be resting on low to medium level of evidence. Furthermore, given the epidemiologic study design, the definition of SBO was based on diagnostic and operation codes which may result in small margin of error in diagnosis. The errors are unlikely to differ between the groups and the validity of diagnostic codes in the national patient registry have been shown to be high [13].

Conclusion

Division of the greater omentum is associated with reduced risk for SBO after antecolic, antegastric LRYGB

and should be considered as a complement to mesenteric defects closure to further reduce the risk for SBO after LRYGB.

Disclosures

J. Ottosson has received consultant fees from Johnson & Johnson Medical and Vifor Pharma. E. Stenberg has received lecturing fees from Johnson & Johnson Medical. None of the mentioned disclosures were related to the contents of this work. None of the remaining authors declare any conflict of interest. This study was founded by grants from Örebro County Council (OLL-939106), Stockholm County Council, and Strategic Research Programme in Diabetes.

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