CLINICAL RESEARCH

A Survey of Dumping Symptomatology after Gastric Bypass With or Without Lesser Omental Transection

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Abstract

Background Lesser omental transection during gastric bypass for morbid obesity may be associated with postoperative dumping. A survey of postoperative symptoms was performed in patients undergoing laparoscopic Roux-en-Y gastric bypass with transection vs. preservation of the lesser omentum.

Methods A written questionnaire on dumping symptoms was administered to patients 2 years after laparoscopic Roux-en-Y gastric bypass with or without transection of the lesser omentum. Statistical testing was performed to determine whether the rate of various symptoms was related to the transection of the lesser omentum.

Results The patients without lesser omental transection had significantly less symptoms than the patients with transection for 11 out of the 17 symptoms that were queried ($p<0.05$). Ingestion of sweets was associated with dumping symptoms more frequently in the group of transected patients, and this group also had a lower frequency of sweet eating ($p<0.05$).

Conclusion This study demonstrated that transection of the lesser omentum during laparoscopic–gastric bypass was associated with more postoperative dumping symptoms compared to bypass with preservation of the lesser omentum. This association may be secondary to a partial vagotomy that may occur if the lesser omentum is transected during gastric bypass.

Keywords Gastric bypass · Morbid obesity · Vagotomy · Postvagotomy syndrome · Dumping · Bariatric surgery · Minimally invasive surgery

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Introduction

Creation of a small proximal gastric pouch during laparoscopic gastric bypass typically involves gastric partition with a linear stapling device [1–4]. Placement of the stapler for gastric pouch creation requires access to the posterior gastric surface, which may be exposed by traversing the lesser omentum, i.e., entering the lesser sac. Traversal of the lesser omentum can result in transection of some branches of the vagus nerve, including the anterior and posterior nerves of Latarjet, which might leave the patient with a partial vagotomy. Whether vagal branches actually are transected depends on vagal anatomy in each patient, which is variable [5], and whether or not the lesser omentum actually is cut during lesser sac entry. The long-term physiologic consequence of lesser omental transection

during laparoscopic gastric bypass is not clear. Anecdotally, we noted some postvagotomy symptoms (i.e., dumping [6]) in patients who had laparoscopic–gastric bypass with lesser omental transection. Such symptoms seemed to be less severe in other gastric bypass patients who did not have omental transection. The implication was that lesser omental transection had resulted in a partial vagotomy, which subsequently increased the susceptibility to dumping. In order to determine if there was an association between lesser omental transection and postoperative dumping, we conducted a survey of dumping symptomatology in patients who had gastric bypass with vs. without transection of the lesser omentum.

Materials and Methods

Handling of Lesser Omentum during Gastric Bypass Procedure

Laparoscopic gastric bypass with Roux-en-Y gastrojejunostomy was performed for the indication of morbid obesity (BMI≥40, or ≥35 with comorbidities) as previously described [3]. Two techniques of gastric pouch creation were utilized, one employing transection of the lesser omentum, and the other preserving the lesser omentum. For the omental-transecting procedure, the lesser sac was entered through the translucent region of the lesser omentum, a region which typically overlies the caudate lobe of the liver (Fig. 1a), and informally is known as the "pars flaccida" (as it resembles the tympanic membrane structure of the same name). The lesser omentum between this window and a point on the lesser curve approximately 5 cm distal to the gastroesophageal junction was then transected with either a linear stapler or an ultrasonic scalpel. Exposure to the posterior gastric surface thereby was obtained, and creation of the gastric pouch progressed as described [3].
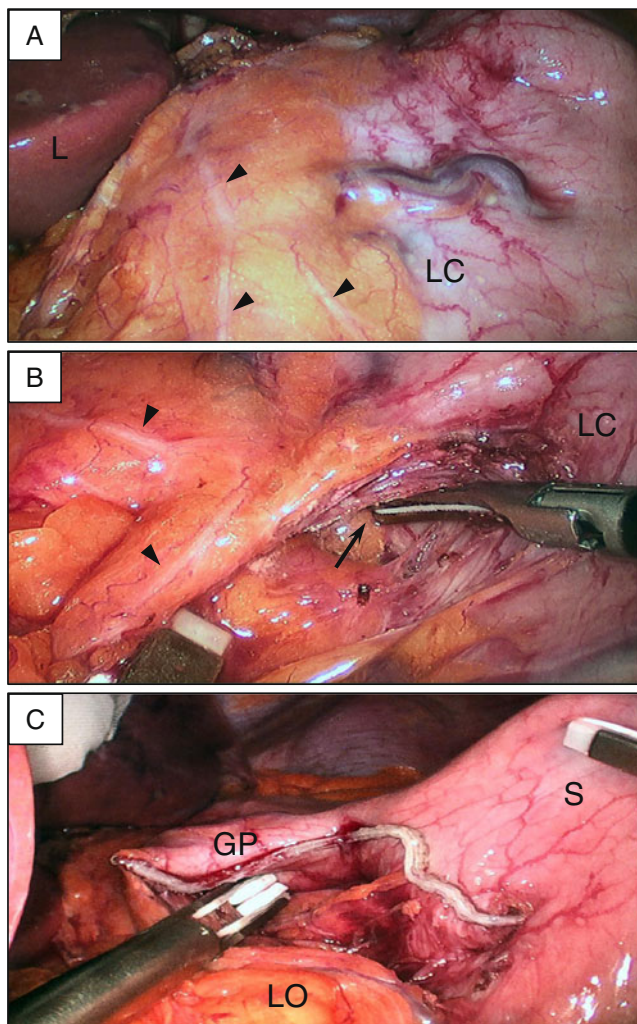
In the omental-sparing procedure, the lesser sac was entered via perigastric dissection approximately 5 cm distal to the gastroesophageal junction (Fig. 1b), with care taken to preserve the anterior and posterior nerves of Latarjet (Figs. 1b and 2a, b). This dissection remained directly adjacent to the gastric wall (i.e., "hugging" the lesser curve of the stomach) until the lesser sac was entered. The window thus, created allowed passage of a stapler jaw along the posterior gastric surface (Fig. 2c). This method of stapler placement during gastric pouch creation avoided transection of the lesser omentum (Figs. 1 and 2), which often contains the nerves of Latarjet [5].

All omental-transecting procedures were performed under the supervision of one surgeon, and all omental-preserving procedures were performed under the supervision
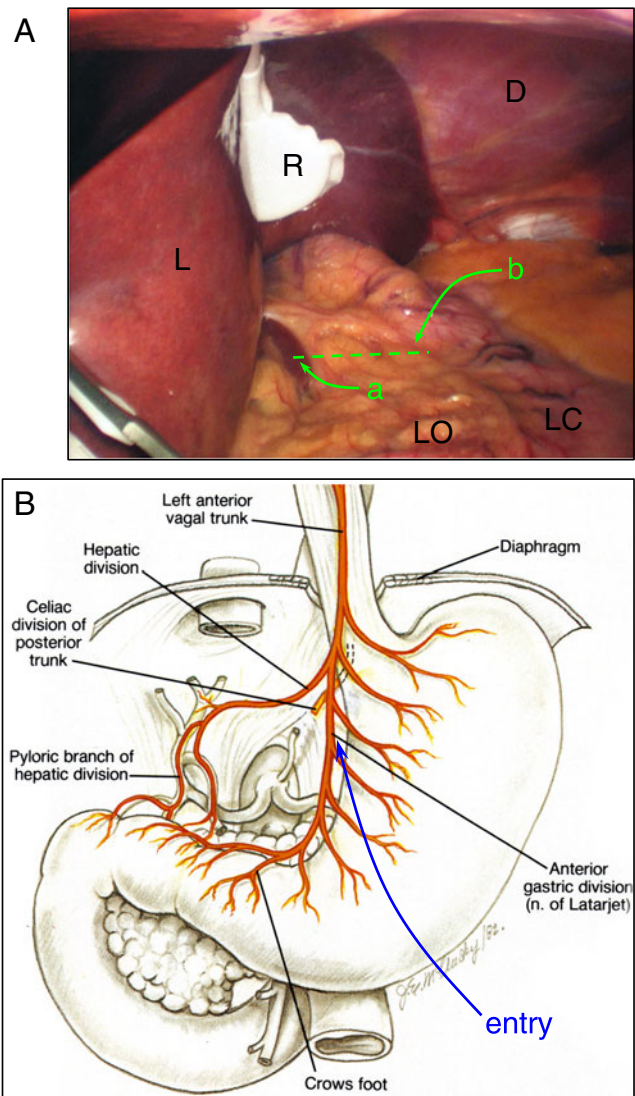
Fig. 1 Lesser curve dissection with and without transection of the lesser omentum. **a** Intraoperative photograph of relevant anatomy, demonstrating the translucent region of the lesser omentum (*a*), where a window is created for the omental-transecting procedure. The point of lesser sac entry for the omental-preserving procedure also is shown (*b*). The *dotted line* indicates the approximate course of omental transection for the former procedure. *D* diaphragm, *L* liver, *LC* lesser curve of the stomach, *LO* lesser omentum, *R* retractor. Image adapted with permission from reference [3]. **b** Intra-abdominal vagal anatomy. The point at which the perigastric dissection is initiated for entry into the lesser sac is indicated by the *arrow*. Image adapted with permission from reference [30]

of another surgeon at a different hospital. Other than the difference in the intraoperative handling of the lesser omentum, the performance of the laparoscopic gastric bypass was similar between these two surgeons (one had been trained by the other). For the purposes of this manuscript, the patients undergoing laparoscopic gastric bypass with transection of the lesser omentum will be referred to as the transection group, and the patients undergoing bypass with

Fig. 2 Intraoperative photographs showing the omental-sparing technique during laparoscopic Roux-en-Y gastric bypass. **a** The nerves of Latarjet (*arrowheads*) from the vagus are shown in the lesser omentum along the lesser curve (*LC*) of the stomach. *L* liver. **b** Dissection between the lesser omentum and the lesser curve was performed about 5 cm distal to the gastroesophageal junction. Note that the nerves of the Latarjet (*arrowheads*) have been swept medially, to the patient's right. The tip of the ultrasonic scalpel (*arrow*) is in the lesser sac. **c** The linear stapler-cutter was applied horizontally across the stomach (*S*), beginning the creation of the gastric pouch (*GP*). Note that the lesser omentum (*LO*), containing the nerves of the Latarjet, has been preserved. The gastric pouch then was completed with a vertical application of the linear stapler-cutter, towards the angle of His

preservation of the lesser omentum will be referred to as the nontransection group.

Administration of the Questionnaire

The written questionnaire (Fig. 3) on dumping symptomatology [6] was administered once to each subject in an office setting. An office assistant handed a hard copy of the

questionnaire to each subject upon completion of the follow-up office visit at the 24–30-month postoperative interval. Each subject had undergone a laparoscopic gastric bypass with Roux-en-Y gastrojejunostomy between 24 and 30 months earlier. Each subject was asked to complete the written questionnaire prior to leaving the office. Symptoms selected for inclusion in this questionnaire were based on Sigstad's criteria [7]. This study was conceived after all subjects (a consecutive series) had undergone surgery; i.e., this study was retrospective, and not a controlled trial. The database of this study was maintained without subject identifiers. Laboratory exclusion criteria for this study included: vitamin B_{12} deficiency (<130 ng/mL); folate deficiency (<200 ng/mL); hypoproteinemia (total protein< 6.3 g/dL); iron deficiency (iron<20 μg/dL and TIBC> 250 μg/dL); anemia (Hb<12); and hypothyroidism (free T4<0.7 ng/dL and TSH>6 mIU/L). In addition, any patient who suffered from anastomotic stricture or ulcer was excluded from this study.

In addition to the above survey data, the following demographic data was maintained in the database of this study: age, sex, height, preoperative weight, and weight at the 18-month follow-up clinic visit. The following information was not maintained in the database: preoperative comorbidities; operative time; number of patients excluded and reasons for the exclusions; and serum glucose values.

Calculation of Relative Weight Loss

Body weight loss was defined as the difference between preoperative weight and weight at the 18-month postoperative visit. Relative weight loss was expressed as (body weight loss÷preoperative weight)×100, and is denoted in Table 1 as "weight loss as% of preoperative weight."

Statistical Analysis

Survey responses were tabulated in a spreadsheet, and statistical testing was done with PC SAS version 9.1.3 (www.sas.com). Fisher's Exact Test or Chi-square tests were used to determine if lesser omental transection and symptom frequency (categorized as none, low, mid, high, and daily) were independent of each other. The unpaired t test was used to compare continuous numerical data between the two patient groups. The level of significance was defined as $p<0.05$.

Results

The patients included in this study underwent their bariatric procedure in 2004–2005, and were administered the survey in 2006–2007. The transection and nontransection groups

Fig. 3 Questionnaire on symptoms associated with postvagotomy (dumping) syndrome, given to patients who had laparoscopic Roux-en-Y gastric bypass

Post Bariatric Surgery Questionnaire

1. How many times per week do you eat sweet foods?

2. Indicate below any physical symptoms encountered when eating sweet foods:

Symptom	Never	Rarely	Sometimes	Often	Always
a. Almost fainting					
b. Desire to lie down					
c. Shortness of breath					
d. Weakness					
e. Sleepiness					
f. Palpitations					
g. Restlessness					
h. Dizziness					
i. Headache					
j. Feeling warm, sweaty, clammy					
k. Nausea					
l. Fullness in abdomen					
m. Stomach gurgling					
n. Belching					
o. Vomiting					
p. Abdominal cramping					

3. What kinds of foods caused the physical symptoms? Circle Below.
   a. Chocolate and candy
   b. Cake, pie, cookies, pastry
   c. Ice cream
   d. Snack sweets (caramel corn, little debbies, etc.)
   e. Sweetened cereal
   f. Crackers or chips
   g. Oily or greasy foods
   h. Sauces or dressings

Today's date:

Date of surgery:

consisted of 48 and 64 subjects, respectively. The patient age, sex, preoperative weight, preoperative BMI, 18-month follow-up weight, and 18-month follow-up BMI were not significantly different between the transection and non-transection groups (see Table 1). In addition, both the absolute and relative weight loss at the 18-month follow-up visit also was not different between the two patient groups (Table 1).

Table 1 Patient characteristics of the transection ($n=48$) vs. the nontransection ($n=64$) group

Characteristic	Transected	Nontransected	p value[a]
Number of female subjects	39	51	0.19
Age (mean ± sd)	43±13	46±13	0.38
Age (median; range)	43; 21–73	44; 20–68	na
Preoperative weight, kg (mean ± sd)	138.4±28.4 (39.2%)	136.3±29.1 (39.1%)	0.70
Preoperative weight, kg (median; range)	132.0; 94.5–202.3	130.0; 88.2–230.9	na
Preoperative BMI (mean ± sd)	49.5±9.0	48.5±9.0	0.57
Weight loss, kg (mean ± sd)	54.3±15.8	53.3±15.6	0.74
Weight loss, kg (median; range)	50.5; 27.7–95.5	50.0; 30.5–111.8	na
Weight loss as% of preoperative weight (mean ± sd)	38.8±4.9	38.6±5.4	0.95
Follow-up BMI (mean ± sd)	30.1±4.6	29.5±5.0	0.52
Follow-up BMI (median; range)	29.3; 20.8–41.7	28.7; 21.1–46.0	na

[a] p value, transection vs. nontransection, determined with Fisher's Exact Test (no. female subjects) or unpaired t test (all others)

The frequencies of physical symptoms associated with eating sweet foods in the transection vs. nontransection groups are shown in Table 2. Of the 17 queried symptoms, 11 occurred more frequently in the transection than in the nontransection patients ($p<0.05$); the frequencies of the remaining six symptoms were not different between groups. None of the 17 queried symptoms in Table 2 were more common in the nontransection group. Representative frequency plots with either a significant or nonsignificant difference between the two patient groups are shown in Fig. 4. The rightward shift of the bars of the transection group with respect to the bars of the nontransection group in the diarrhea frequency plot is readily apparent (Fig. 4a), while no such shift is evident in the dyspnea frequency plot (Fig. 4b).

Food types associated with physical symptoms are shown in Table 3. These food types were mostly sweet

and/or had a high glycemic index, and were included in the questionnaire because of their propensity to induce dumping symptoms. In six of the eight queried categories, there was a relationship with the integrity of the lesser omentum; in all of these associations, the patients with omental transection had a higher frequency of physical symptoms compared to the nontransection patients ($p<0.05$). The frequency (in episodes per week) of sweet food ingestion in transection vs. nontransection patients is shown in Table 4. The nontransection patients reported higher frequencies of sweet eating compared to the transection patients ($p<0.05$).

Discussion

The technique of gastric bypass has undergone continual evolution since its popularization in the 1970s [8–11].

Table 2 Results of symptom survey of gastric bypass patients with ($n=48$) vs. without ($n=64$) transection of the lesser omentum

Symptom	Status	Frequency of symptom (% of patient group)					p value[a]
		None	Low	Mid	High	Daily	
Diarrhea	T	10	19	33	29	8	<0.01
	NT	77	16	8	0	0	
Cramping	T	21	38	10	21	10	<0.01
	NT	62	14	19	3	2	
Nausea	T	19	25	38	17	2	<0.01
	NT	55	17	23	5	0	
Flushing	T	25	19	27	19	10	<0.01
	NT	67	17	9	6	0	
Dizziness	T	27	23	31	17	2	<0.01
	NT	66	11	23	0	0	
Somnolence	T	29	15	40	10	6	<0.01
	NT	62	16	16	3	3	
Gurgling	T	33	6	8	33	19	<0.01
	NT	39	14	27	11	9	
Vomiting	T	44	12	25	19	0	<0.01
	NT	77	11	12	0	0	
Near Syncope	T	50	33	15	2	0	<0.01
	NT	89	8	3	0	0	
Palpitations	T	50	21	19	10	0	0.01
	NT	78	9	11	2	0	
Headache	T	52	21	23	4	0	0.01
	NT	78	14	8	0	0	
Belching[b]	T	*33*	*17*	*35*	*2*	*12*	*0.27*
	NT	*55*	*12*	*22*	*2*	*9*	
Fullness[b]	T	*38*	*12*	*29*	*15*	*6*	*0.34*
	NT	*56*	*12*	*17*	*9*	*5*	
Recumbency[b]	T	*38*	*31*	*19*	*12*	*0*	*0.34*
	NT	*55*	*20*	*12*	*11*	*2*	
Restlessness[b]	T	*60*	*19*	*15*	*6*	*0*	*0.39*
	NT	*73*	*14*	*9*	*2*	*2*	
Weakness[b]	T	*67*	*19*	*8*	*2*	*4*	*0.43*
	NT	*66*	*12*	*19*	*2*	*2*	
Dyspnea[b]	T	*81*	*10*	*4*	*4*	*0*	*0.48*
	NT	*83*	*14*	*3*	*0*	*0*	

Symptoms with values in italics did not reach statistical significance

T lesser omentum transected, *NT* lesser omentum not transected

[a] p value, N vs. NT, determined with Fisher's Exact Test or Chi-square test. Some rows do not add up to 100% because of rounding errors

Fig. 4 **a** Frequency of diarrhea in patients with transection vs. nontransection of the lesser omentum during gastric bypass. **b** Frequency of dyspnea in transected vs. nontransected patients. Results of Fisher's Exact test shown in each plot
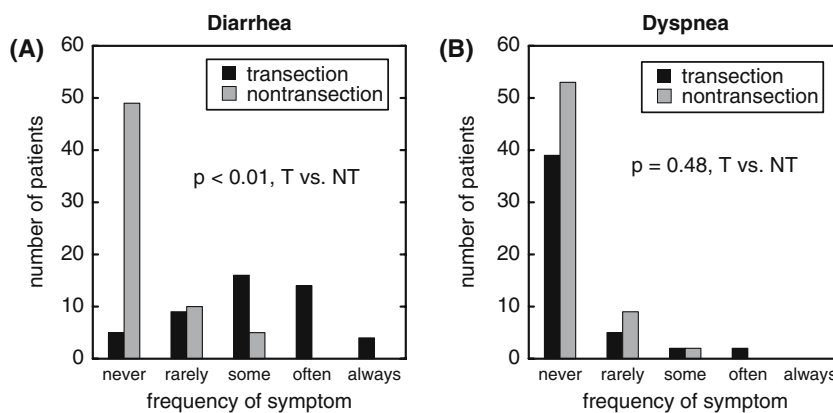
Creation of a proximal small-volume gastric pouch has been a regular feature of gastric bypass. In order to create such a pouch, the surgeon needs access to the space posterior to the gastric cardia, a space which is continuous with the lesser sac and can be accessed through the lesser omentum. In the era of open surgery, the lesser sac was accessed by either dividing the lesser omentum up to the lesser curve of the stomach [12, 13], or by dissecting through the lesser omentum along the edge of the lesser curve [14, 15]. In the former instance, the lesser omentum (and presumably the vagal fibers therein) was transected.

Both omental transection [2, 16–18] and preservation [3, 4, 19–21] have appeared in published descriptions of laparoscopic gastric bypass. The likely rationale for omental transection during gastric bypass is that access to the retrocardia is technically easier with this technique, compared to perigastric dissection and omental preservation. It has not been clear whether the integrity of the lesser omentum in this situation has mattered, or what the consequence of its transection might be. Guidelines for

minimally invasive bariatric surgery published in 2008 do not address this issue [22].

There is a well-established, if variable, incidence of the dumping syndrome after gastric bypass surgery for morbid obesity [23, 24]. In one study of 137 open gastric bypass patients, the incidence of postoperative dumping was 76% [23]. The surgical handling of the lesser omentum in this series was not specified. A randomized trial comparing open gastric bypass vs. vertical-banded gastroplasty documented a 50% incidence of dumping after the former procedure [25]. The surgical technique in this trial involved incision of the gastrohepatic ligament "lateral to the left gastric artery," with an opening made in the lesser omentum made along the lesser curvature; it is not clear how much of the lesser omentum was transected in this trial. A review of private health insurance claims in a series of 1,760 bariatric patients found a 15.7% incidence of dumping [26]; surgical details from this database were not available.

The etiology of dumping after gastric bypass is multifactorial, and may simply involve rapid pouch emptying, or more insidious causes such as nesidioblastosis (pancreatic islet hyperfunction) [27, 28]. The role of the vagus nerve in dumping after gastric bypass has not been clear. In a 1980 study on surgical treatment of morbidly obese patients,

Table 3 Association of food types with physical symptoms in patients with transection vs. no transection of the lesser omentum during gastric bypass

Food type	Transection (%)	Nontransection (%)	p value[a]
Ice cream	96	28	<0.01
Chocolate/candy	81	28	<0.01
Cake, pie, cookies, pastry	65	17	<0.01
Greasy food	58	33	<0.01
Snack sweets	58	13	<0.01
Sweetened cereal	23	6	0.01
Sauces/dressings	19	9	0.15
Crackers/chips	6	9	0.24

Percentages represent the fraction of the respective patient group

[a] p value, transection vs. nontransection, determined with Fisher's Exact or Chi-square test

Table 4 Frequency of sweets ingestion in patients with transection vs. nontransection of the lesser omentum during gastric bypass

Episodes of sweets ingestion per week	Transection (%)	Nontransection (%)
Never	8	8
<1	33	6
1–2	40	28
3–5	10	33
6–7	6	20
>7	2	4
	p<0.01[a]	

[a] p value, transection vs. nontransection, determined with Chi-square test

truncal vagotomy alone resulted in an average loss of 22.5 kg in six of seven patients [29]. The effect of the vagotomy in this study was attributed to a decrease in hunger, however, and not dumping. Overall, the effect of postoperative dumping on the efficacy of gastric bypass is controversial and incompletely studied [23, 25]. The occurrence of dumping nevertheless is distressing to the patient. Reduction of this side effect without decreasing the efficacy of gastric bypass would be desirable.

In the present survey-based study, the severity of dumping symptoms after laparoscopic gastric bypass was compared between two surgeons. Their operative techniques were similar, except that one surgeon transected the lesser omentum (also known as the gastrohepatic ligament) during gastric pouch creation, while the other surgeon preserved the lesser omentum. The survey results indicated that dumping symptomatology was worse in patients who had lesser omental transection compared to patients who had lesser omental preservation. Analysis of weight loss data in the patients of this report indicated that weight loss was not affected by the surgical handling of the lesser omentum, at least in the 18-month follow-up period in which weights were entered into the database. A definitive conclusion on the effect of omental transection on weight loss would require a longer follow-up period. In any event, the fact that early follow-up weight loss was not different between the transection and nontransection groups would suggest that dumping per se is not necessary for the efficacy of a gastric bypass.

This study was intended to evaluate dumping symptomatology only. Data on postoperative sequelae, such as anastomotic stricture or ulcer, were not entered into the database of this study. A manuscript describing the authors' data on perioperative outcome, long-term weight loss, and postoperative sequelae in a larger series of laparoscopic gastric bypass patients ($n=1,692$) is in preparation. Preliminary data from this larger series (which incorporates all of the patients from the present study) indicated that the authors' incidence of leak, ulceration, and stenosis associated with the gastrojejunostomy was 0.2, 0.6, and 0.3%, respectively (unpublished observations).

There are several caveats to this study. First, this was not a controlled trial, but a patient survey that was conceived after all studied patients had undergone their gastric bypass. So the study is subject to (1) critiques of bias that apply to retrospective studies, and (2) critiques of imprecision that apply to survey-based studies. Furthermore, one surgeon supervised all omental-transecting bypass procedures, while another surgeon supervised all omental-preserving procedures. Although it is the authors' opinion that the surgical technique was similar (excepting the omental handling) between these two surgeons, this similarity is not absolute. And finally, no pathologic or physiologic testing of vagal

status was performed, so the status of the vagus nerve in either patient group was unknown.

Since the status of the vagus nerve in the subjects of this study was unknown, we have used the purely descriptive terms of transection vs. nontransection of the lesser omentum, and have avoided use of terms as such as "vagotomy" vs. "nonvagotomy." If Fig. 2a–b is examined, however, it is apparent that transection of the lesser omentum in this particular patient would have resulted in division of some prominent vagal fibers. It is thus plausible that some postvagotomy symptoms might have occurred if the lesser omentum had been cut in this patient (which it was not). Assuredly, vagal branches within the lesser omentum will not be as obvious in all patients as the branches were in the patient of Fig. 2. This figure does provide a visual cue to a possible consequence of lesser omental transection during gastric bypass.

We have collected data which suggests that omental transection during laparoscopic gastric bypass is associated with a high incidence of postvagotomy symptomatology, specifically dumping [6]. We would suggest that omental transection during gastric bypass results in transection of vagal fibers contained within the lesser omentum [5], which subsequently increases the risk for dumping. As discussed above, however, we do not have corroborative pathologic or physiologic data on the vagal nerves in our patients, so the precise extent of vagotomy was unknown. We would suggest that if a bariatric surgeon notes a high incidence of dumping in patients who underwent a laparoscopic gastric bypass with omental transection, then the solution might be to switch to the omental-preserving technique.

Conflict of Interest Statement The authors state that they have no conflict of interest.

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