



Prevalence of Dumping Syndrome After Laparoscopic Sleeve Gastrectomy and Comparison with Laparoscopic Roux-en-Y Gastric Bypass

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Abstract

Background Dumping syndrome is a well-known side effect of laparoscopic gastric bypass (LRYGB), and it is commonly believed that dumping syndrome is less likely to occur after laparoscopic sleeve gastrectomy (LSG), due to the preservation of the pyloric sphincter. However, it is not uncommon for patients undergoing LSG at our center to report symptoms suggestive of dumping syndrome.

Objective To assess the prevalence of symptoms of dumping syndrome after LSG compared with LRYGB.

Setting A single surgical group at a high-volume (700 cases per year) Bariatric and Metabolic Surgery Center of Excellence.

Methods One thousand four hundred seventy-one LRYGB (366) and LSG (1105) patients received a questionnaire to assess symptoms of dumping syndrome, utilizing a modified version of the Sigstad scoring system. Dumping syndrome was considered to be present when the questionnaire score exceeded a threshold value.

Results A total of 360 responses were received (249 LSG, 111 LRYGB). 26.5% (66) LSG and 41.4% (46) LRYGB exceeded the threshold for dumping syndrome ($p < 0.01$). 84.8% (56) LSG and 84.7% (39) LRYGB reported early dumping syndrome ($p > 0.05$). Thirty-six percent (24) LSG and 28% (13) LRYGB reported late dumping syndrome ($p > 0.05$). Twenty-seven percent (62) LSG and 44.4% (44) LRYGB reported at least one symptom of dumping syndrome with sweets ($p < 0.05$). 34.3% (85) LSG and 35.5% (39) LRYGB reported symptoms when drinking with or within 30 min of a meal ($p > 0.05$). 14.5% (36) LSG and 17.3% (19) LRYGB reported symptoms after alcohol consumption ($p > 0.05$).

Conclusion Dumping syndrome after LSG is prevalent but has not been widely reported. This finding may impact clinicians and patients in their choice of procedure and has relevance in post-operative education and care.

Keywords Dumping syndrome · Laparoscopic sleeve gastrectomy · Laparoscopic gastric bypass

Introduction

Laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG) are the most common bariatric surgical procedures performed worldwide for morbid obesity [1]. Some of the well-known side effects of LRYGB are dumping syndrome, classified as early or late dumping. Dumping syndrome is a symptom complex seen after other

gastric surgeries as well [2, 3]. Early dumping syndrome results from the hastened gastric emptying of hyperosmolar content into the intestine, causing osmotic fluid shifts from the blood into the intestinal lumen. It is categorized by symptoms that occur within 1 h after the ingestion of a meal, and symptoms may be gastrointestinal (diarrhea, borborygmi, nausea, abdominal pain, and bloating) or vasomotor (fatigue, palpitations, sweating, tachycardia, hypotension, tremors, desire to lie down, facial flushing, syncope, and hunger) [2–9]. Late dumping occurs between 1 and 3 h postprandial and includes symptoms attributed to reactive hypoglycemia such as dizziness, extreme hunger, confusion, sweating, and blurred vision. Reactive hypoglycemia is caused by a surge in insulin secretion that overcompensates for transient hyperglycemia that occurs after ingestion of carbohydrates in patients after

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LRYGB. This is due to the rapid delivery and absorption of unprocessed sugars and carbohydrates to the mid-jejunum as occurs after LRYGB [10].

Symptoms suggestive of dumping syndrome have been reported by many patients in our program and at other programs. However, it is a commonly held belief that dumping syndrome is less likely to occur after LSG due to the preservation of the pylorus. We designed this study in order to objectively assess the presence and prevalence of dumping syndrome in day-to-day life without the performance of provocative tests in patients who have undergone LSG. A secondary aim of the study was to assess the prevalence of symptoms of dumping syndrome after the ingestion of particular food groups and eating behaviors such as drinking with meals and alcohol consumption.

Materials and Methods

Selection and Description of Participants

For this descriptive cohort study, we used a database of all patients who underwent bariatric surgery at a single Center of Excellence in Bariatric and Metabolic Surgery between January 2014 and May 2016 with Institutional Review Board (IRB) approval. All patients met the National Institutes of Health consensus criteria for bariatric surgery with either a body mass index (BMI) of 40 kg/m² or above or a BMI between 35 and 40 kg/m² with at least one obesity-related comorbidity [11]. All patients underwent pre-operative assessment including counseling by dietitians and psychologists. All surgeries were performed in an identical fashion using a specified protocol by a single group of three surgeons. Demographics of the study population are presented in Table 1. One thousand four hundred seventy-one patients met the above criteria and were invited to complete an online or paper questionnaire. Patients who had undergone a previous bariatric procedure, such as laparoscopic adjustable gastric banding (LAGB) or LSG, were not excluded. The questionnaire was answered by 360 patients, producing a response rate of 24.5% (360/1471). 22.5% of LSG patients responded,

and 30.0% of LRYGB patients responded. The demographics of the response group are represented in Table 2.

Operative Technique

All patients underwent an identical procedure. LSG patients underwent an initiation of the division of the greater curvature at a point 5 cm from the pylorus. Reinforced Covidien® staplers with black cartridge were used in all patients (Covidien-Medtronic, Minneapolis, MN). The final stapling was performed immediately adjacent to the gastroesophageal junction fat pad. A Visigi 3D®, Boehringer Labs, 36 French bougie, was used in all patients and the stapler was applied a few millimeters away from the bougie in all cases.

In cases of LRYGB, the pouch was created by a division of the lesser curvature with Covidien® un-reinforced purple cartridge at a distance of 6 cm from the gastroesophageal junction. A lesser curve-based pouch was used. The pouch size measured approximately 45 mm that was fired to a distance of 30 mm in all cases. The length of the biliopancreatic limb was about 50 cm and the length of the alimentary limb was about 120 cm in all cases. All surgeries were performed identically by three surgeons from a single surgical group who assisted each other in all operations.

Questionnaire

The self-assessment questionnaire consisted of a total of 15 questions. Patients were asked to respond to questions related to the presence of specific symptoms after eating or drinking. However, the term “dumping syndrome” was not mentioned in order to reduce the potential for response bias. Patients were instructed to answer “yes” to a symptom only if it began after surgery or increased in frequency. The first 10 questions served to assess the presence of symptoms suggestive of dumping syndrome and were based on the Sigstad scoring tool. The final 5 questions were designed to assess the presence of symptoms of DS related to drinking with meals, alcohol consumption, decreased alcohol tolerance, and whether the patient was currently taking medication for type 2 diabetes (T2D) (Fig. 1).

Table 1 Characteristics of the LSG population as compared with the LRYGB population

Baseline demographics	LSG (<i>n</i> = 1105)	LRYGB (<i>n</i> = 366)
M/F (% female)	280/825 (74.7)	111/255 (69.7)
Initial age, mean (SD)	43 (± 13)	49 (± 10)
Pre-operative BMI, mean (SD)	43.5 (± 5.8)	43.7 (± 6.4)
Pre-operative comorbidities	LSG (<i>n</i> = 1105)	LRYGB (<i>n</i> = 366)
Type 2 diabetes mellitus, <i>n</i> (%)	135 (12.2)	89 (24.3) (<i>p</i> < 0.001)
Sleep apnea, <i>n</i> (%)	247 (22.4)	81 (22.1) (<i>p</i> = 0.930)
Hypertension, <i>n</i> (%)	336 (30.4)	150 (40.9) (<i>p</i> < 0.001)

Table 2 Characteristics of questionnaire respondents for LSG as compared to LRYGB patients

Response rate, <i>n</i> (%)	360 (24.5)		
Baseline demographics	LSG	LRYGB	<i>p</i> value
Response rate, <i>n</i> (%)	249 (22.5)	111 (30.3)	0.003
Time from surgery to survey, months (SD)	16.59 (\pm 8.20)	19.35 (\pm 8.50)	0.768
M/F (% female)	53/196 (78.7)	30/81 (73.0)	0.232
Age, mean (SD)	47 (\pm 12.29)	51 (\pm 8.57)	0.001
Pre-operative BMI, mean	43.7 (\pm 5.60)	43.7 (\pm 5.57)	0.919
Pre-operative comorbidities	LSG	LRYGB	<i>p</i> value
Type 2 diabetes mellitus, <i>n</i> (%)	43 (17.2)	44 (39.6)	< 0.001
Sleep apnea, <i>n</i> (%)	63 (25.3)	30 (27.0)	0.730
Hypertension, <i>n</i> (%)	99 (39.8)	53 (47.8)	0.156

The Sigstad scoring system is a tool devised as a diagnostic index to identify dumping syndrome in partial gastrectomy patients and has been utilized following an oral glucose challenge [4]. The original tool includes 16 symptoms with varying weightages that are totaled and compared to a clinical threshold of 7 to identify dumping syndrome. We adapted the tool for greater suitability for patient self-reporting in the absence of provocation by decreasing the number of symptoms to 10 and adjusted the weightages and clinical threshold accordingly. The 6 symptoms of shock, syncope, dyspnea, headache, borborygmus, and eructation were removed to more accurately reflect the symptom pattern seen in post-operative LRYGB and LSG patients, and the clinical threshold was reduced to 3.26. The modified diagnostic tool was statistically correlated with the Sigstad scoring tool (Table 3). In order to assess the prevalence of early and late dumping syndrome, for each affirmative symptom response, patients were asked to report if symptom onset was either less than 1 h or within 1–3 h after eating. Symptom onset less than 1 h was considered early dumping syndrome. To further assess the relationship of dumping symptoms to specific food types, patients were asked to select from a list of common food triggers for each symptom. The options included were sweets, fried foods, bread, pasta/rice, juice, dairy, none, or other.

Statistical Analysis

Statistical analyses were executed using IBM SPSS Statistics. To determine differences between LSG and LRYGB, independent *t* tests were used, utilizing Levene's test when unequal variances were suspected. Differences between groups were evaluated utilizing Pearson's chi-square to identify any statistically significant differences among groups and subgroups within subject demographics and the clinical variables.

Results

Prevalence of Dumping Syndrome

In the LSG group, 66 of the 249 (26.5%) patients met the criteria for dumping syndrome. In the LRYGB group, 46 of the 111 (41.4%) patients met the criteria for dumping syndrome. Results indicated there was a statistically significant difference between the LSG and LRYGB groups who met the criteria for dumping syndrome (χ^2 (1, N = 360) = 7.99, p < 0.01).

Prevalence of Early and Late Dumping Syndrome

Of the LSG patients who met criteria for dumping syndrome, 56 of the 66 (84.8%) reported early symptom onset. Of the LRYGB patients who met criteria for dumping syndrome, 39 of the 46 (84.7%) reported early symptom onset, which did not show a statistically significant difference between procedure type (p > 0.05).

Of the LSG patients who met criteria for dumping syndrome, 24 of the 66 (36.3%) reported late symptom onset. Of the LRYGB patients who met criteria for dumping syndrome, 13 of the 46 (28.2%) reported late symptom onset (p > 0.05). In the LSG group, 19 (28.8%) reported both early and late symptoms of dumping syndrome, while in the LRYGB group, 11 (23.9%) reported both early and late symptoms (χ^2 = 0.5621 (p = 0.755)). This is represented in Fig. 2.

Prevalence of Symptoms Suggestive of Dumping Syndrome with Certain Food Types, Drinking with Meals, and Alcohol Consumption

In the LSG group, 62 patients (24.9%) reported at least one symptom of dumping syndrome with the consumption of sweets, while in the LRYGB group, 44 (39.7%) patients reported at least one symptom of dumping syndrome with

<i>Patient Information</i>						<i>Date</i>
Name (First, Last M)						DOB
Surgery Type				Surgery Date		Current Weight

Since your Bariatric Surgery, have you experienced the following symptoms after eating? Please reply “yes” only if symptom first began after surgery or increased in frequency. For each “yes” please specify whether this symptom occurred less than 1 hour or 1-3 hours after eating. In addition, please circle the food(s) you suspect may have triggered the symptom.

				YES	NO	<1 HOUR	1-3 HOURS
1. DESIRE TO LIE DOWN				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
2. WEAKNESS				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
3. SLEEPINESS				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
4. PALPITATIONS				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
5. RESTLESSNESS				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
6. DIZZINESS				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
7. FEELING WARM, SWEATY, CLAMMY				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
8. NAUSEA				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
9. VOMITING				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	
10. ABDOMINAL CRAMPING				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sweets	Fried Foods	Breads	Pasta/Rice	Juice	Dairy	None / Other	

11. Do you experience the above symptoms if you drink with meals or drink less than 30 minutes after eating?

N/A YES NO

12. Have you experienced any of the following symptoms after drinking alcohol? Please check all that apply.

Do not drink alcohol None Weakness Palpitations Restlessness Dizziness
 Desire to lie down Vomiting Abdominal Cramping Feeling warm, sweaty, clammy

13. If yes, how long after drinking alcohol do symptoms occur?

<1 HOUR 1-3 HOURS

14. Do you have a decreased tolerance to alcohol or increased alcohol sensitivity since surgery?

N/A YES NO

15. Are you currently taking medication for diabetes? If yes, please specify medication name.

YES NO MEDICATION _____

Thank you for taking the time to answer this questionnaire!

Fig. 1 Questionnaire distributed to patients

Table 3 Modification of the Sigstad scoring system. Scores were statistically correlated and criterion validity was established

Original value	Sigstad score	Modified tool score	Modified value
+5	Shock	–	
+4	Desire to lie or sit down	Desire to lie or sit down	+ 3.0
+4	Fainting, syncope, unconsciousness	–	+ 2.5
+3	Breathlessness, dyspnea	–	+ 2.0
+3	Palpitation	Palpitation	+ 2.5
+3	Weakness, exhaustion	Weakness	+ 2.5
+3	Sleepiness, drowsiness, apathy, falling asleep	Sleepiness	+ 2.0
+2	Restlessness	Restlessness	+ 1.5
+2	Dizziness	Dizziness	+ 1.5
+1	Nausea	Nausea	+ 1.0
+1	Headaches	–	
+1	Feeling of warmth, sweating, pallor, clammy skin	Feeling warm, sweaty, or clammy	+ 1.0
+1	Abdominal fullness, meteorism	Abdominal cramping	+ 1.0
+1	Borborygmus	–	–
–1	Eructation	–	–
–4	Vomiting	Vomiting	– 2.5
29		Sum	13.5

$\frac{\text{Dumping Score threshold:7}}{\text{Total possible symptom score:29}} = \frac{x}{13.5} \Rightarrow \text{Clinical dumping threshold} = 3.26$

sweets ($p < 0.05$). With regard to alcohol consumption, 36 (14.5%) LSG patients reported at least one symptom of dumping syndrome after alcohol consumption, while 19 (17.1%) LRYGB patients reported at least one symptom of dumping syndrome with alcohol consumption ($p = 0.499$). With regard to eating behavior, 85 (34.1%) of LSG patients reported at least one symptom of dumping syndrome when drinking with a meal, or within 30 min of a meal, while 39 (35.1%) of LRYGB patients reported at least one symptom of dumping syndrome when drinking with a meal, or within 30 min of a meal ($p = 0.982$). These results are illustrated in Table 4.

Discussion

The prevalence of dumping syndrome after LRYGB is well-established and has been diagnosed and scored using the Sigstad scoring system [7]. Using this method, some studies have reported a prevalence of dumping syndrome to vary between 15 and 70% after LRYGB [8–14]. One study of post-operative LRYGB patients utilized the dumping symptom rating scale and found the incidence of dumping syndrome to be 12%. A registry-based study of 1700 LRYGB patients reported a 16% incidence of dumping syndrome [15, 16]. Additionally, a questionnaire-based study conducted

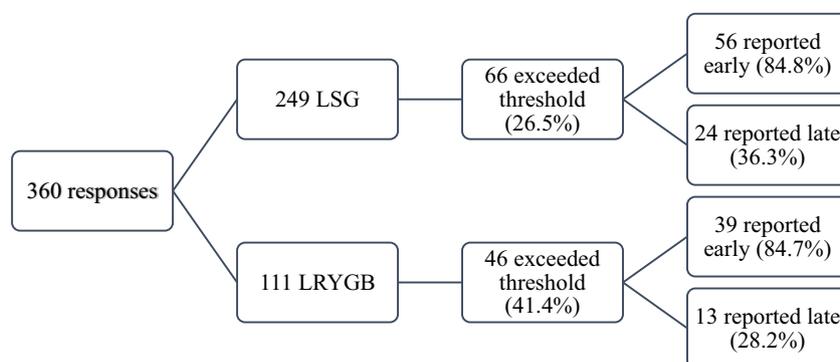


Fig. 2 Three hundred sixty patients responded to the dumping syndrome questionnaire. There was a statistically significant difference between LSG and LRYGB groups who exceeded the threshold for dumping syndrome ($\chi^2=7.99$ ($p < 0.01$)). No significant difference was observed between procedure type when comparing early and late dumping

syndrome ($p > 0.05$). Overlap between early and late dumping syndrome was observed. Both early and late symptoms were reported by 19 LSG (28.8%) and 11 LRYGB (23.9%) patients that exceeded the dumping threshold ($\chi^2=0.562$ ($p = 0.755$))

Table 4 Prevalence of at least one symptom of DS in LSG patients as compared with LRYGB patients

Patients experiencing at least one symptom of dumping with:	LSG (<i>n</i> = 249)	LRYGB (<i>n</i> = 111)	<i>p</i> value
Sweets, <i>n</i> (%)	62 (24.9)	44 (39.7)	< 0.05
Fried foods, <i>n</i> (%)	46 (20.8)	25 (25.8)	0.328
Breads, <i>n</i> (%)	50 (22.2)	23 (23.5)	0.805
Pasta/rice, <i>n</i> (%)	48 (21.4)	28 (29.2)	0.136
Juice, <i>n</i> (%)	13 (5.9)	8 (8.3)	0.420
Dairy, <i>n</i> (%)	25 (11.3)	17 (17.1)	0.123
Alcohol, <i>n</i> (%)	36 (14.5)	19 (17.1)	0.499
Drinking with a meal, or drinking within 30 min after a meal, <i>n</i> (%)	85 (34.1)	39 (35.1)	0.982

by Lee et al. reported a 34% prevalence of complaints related to hypoglycemia and dumping syndrome after LRYGB [17].

Minimal research has been conducted on dumping syndrome after LSG. Reports of provoked dumping syndrome after oral glucose tolerance tests have been recently published by Ramadan et al. in 2016 and Papamargaritis et al. in 2012 [5, 6]. However, a literature search did not identify any studies assessing the presence of dumping syndrome after LSG, in a purely clinical, non-experimental setting. The presence of dumping syndrome after LSG and its impact on a patient's daily life have not been hitherto studied.

Our study shows that dumping syndrome after LSG occurs with a prevalence of 26.5%. No previous studies have assessed the prevalence of dumping syndrome after LSG in the non-experimental setting without provocation. Papamargaritis et al. assessed the prevalence of dumping syndrome after LSG using the Sigstad scoring system and the Arts questionnaire after provocation with 75 g of glucose in an oral glucose tolerance test (OGTT). At 6 months post-surgery, Papamargaritis et al. found that dumping syndrome occurred after provocation with OGTT in 6 (24%) LSG patients. However, they studied only 25 patients, none of whom were diabetic [6]. A previous study by Tzovaras and Papamargaritis found that 14 (45.2%) patients 6 weeks after LSG experienced either definite dumping syndrome or symptoms suggestive of dumping syndrome using OGTT [4]. As dumping syndrome occurs after LSG, this finding has a relevance to the suitability of LSG for sweet eaters. It is likely that due to dumping syndrome, patients may modify their eating behavior to avoid sweets post-operatively in a similar way to what LRYGB achieves. Studies in LSG have indeed shown the maintenance of a healthier diet and a reduced craving of sweets post-operatively by 50% at 1 year and 23% at 2 years compared to baseline [18, 19]. Interestingly, in a murine study, food preferences were similar after LSG as compared with LRYGB [20]. To the best of our knowledge, this is the first study that reports the incidence of symptom patterns consistent with dumping syndrome in LSG patients without the use of provocative tests. In fact, our finding is significant on many

counts. First, the presence of a symptom pattern without specific artificial provocative methods is more relevant from a patient quality-of-life point of view, compared to findings on provocative testing. Second, the presence of dumping syndrome in everyday life among LSG patients is bound to have an impact on food choices and therefore, in some cases, the maintenance of weight loss after LSG, in a manner similar to how it impacts LRYGB. In addition, it is possible that the improved food choices consistently observed in patients after LSG for the first 2 to 3 years compared to purely restrictive procedures such as the LAGB are related to milder forms of dumping syndrome, which may not reach the threshold for diagnosis as established by these criteria. Furthermore, one needs to more fully understand the cause of dumping syndrome in LSG patients. It is conceivable that rapid gastric emptying, which has been shown to occur after LSG, results in the rapid transfer of undigested nutrients into the proximal jejunum in a manner similar to that after LRYGB [21–24]. Based on the hindgut hypothesis, this would result in earlier exposure of incompletely processed nutrients to the ileum. Based on the foregut hypothesis, rapid emptying could result in reduced exposure of the duodenum and proximal jejunum to nutrients [25]. This may have major implications in the amelioration of type 2 diabetes (T2D) after LSG.

Significant changes in the anatomy and physiology occur in the distal esophagus and stomach as after sleeve gastrectomy. These changes may be related to disruption of the angle of His, partial resection of sling fibers, and development of hypotensive lower esophageal sphincter. There is also reduced gastric compliance due to loss of receptive relaxation, resulting in higher intra-gastric pressure. Gastric motility is affected due to resection of the majority of the fundus and gastric pacemaker resulting in rapid gastric emptying [26]. We have found that as a number of peptides and vasoactive substances contribute to the pathogenesis of early and late dumping syndrome, the presence of dumping syndrome in LSG patients may be reflective of changes in the secretion of substances such as neurotensin, vasoactive intestinal

peptide, serotonin, and substance P [27]. This is a fertile field of future research. Finally, it is possible that the prevalence of dumping syndrome after LSG may vary with operative technique. Important parameters that could have a bearing on this would be the distance from the pylorus, which represents the amount of retained antrum, the bougie size, and the distance between the staple line and the gastroesophageal junction, which would reflect the presence of the fundus. Revision surgeries were included in this cohort. However, it would be of interest to investigate the difference of dumping syndrome among patients who have undergone the conversion of LAGB to LSG, as it is conceivable that the poorer weight loss seen after the conversion from LAGB to LSG could be related to an altered hormonal milieu in these patients that may manifest with a reduced incidence of dumping syndrome in this subgroup. Clinical criteria for dumping syndrome based on self-reported questionnaires have been used in the past by other investigators, though only after LRYGB. Since it assesses the incidence of dumping syndrome symptoms, the timing of these symptoms, and the foods which are assumed to provoke symptoms, our modified tool bears similarities to previously validated self-reporting tools such as the Dumping Syndrome Rating Scale used in patients to assess gastrointestinal complaints after LRYGB and the Arts questionnaire, which has been used to differentiate between early and late dumping in LRYGB patients [15, 28].

Currently, we are in the process of analyzing our data in relationship to diabetes and dumping syndrome. There may be profound implications between sleeve and bypass patients. As this was not within the scope of this study, these findings will be a topic for a separate paper.

Some limitations of our study are noted. Symptoms are self-reported, and a larger sample size would improve study power. Additionally, the modified Sigstad score tool was correlated to the original Sigstad; however, this tool will require additional tool validity testing methodology such as the implementation of a content validity index scale, the establishment of criterion validity, and the establishment of construct validity with an exploratory factor analysis.

The overall response rate of 24.5% maybe considered a limitation; however, Yun and Trumbo found email response rates without follow-up may only reach 25–30% [29]. A suggestion for future studies would be to use a multimodal follow-up approach to encourage an increase in response rate [30]. Another possible limitation is the fact that we had a higher response rate among LRYGB [30.3%] patients compared to LSG [22.5%]. This could skew the relative prevalence of dumping syndrome in these patient populations. Due to response bias, it is conceivable that patients who were having symptoms were more likely to respond to our questionnaire compared to patients who were asymptomatic. This could be a confounding variable that could artificially increase the measured prevalence of dumping syndrome.

Other considerations for future study could include patient's weight loss at the time of survey to explore any correlation between dumping syndrome and percent excess weight loss.

Conclusions

Our study is the first to report the prevalence of dumping syndrome in LSG patients in a clinical setting. We also have assessed the incidence of dumping syndrome with specific food items. These findings have a significant relevance for clinicians and patients in their choice of procedure as well as post-operative education and care. Our findings were first presented at 2017 Obesity Week Conference, in Washington D.C., as an oral abstract podium presentation [31].

Compliance with Ethical Standards

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

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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