



Long and Narrow Gastric Pouch versus Classic Globular Pouch in Laparoscopic Proximal Gastric Bypass: Effect on Weight Loss and Dumping Syndrome

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Abstract: *Background:* Laparoscopic proximal gastric bypass Roux-en-Y (LPGBRY) has been regarded for a long time as the gold standard treatment for morbid obesity and its comorbidities. With the presence of the newer strong options, like the gastric sleeve and the mini gastric bypass, refinements in technique are taking place to avoid its current problems. Early and late gastric dumping are known problems after proximal gastric bypass. Modifications in the technique by providing the patient with a long and narrow pouch might help the problem by slowing the gastric emptying time, also should it keep the weight loss in the acceptable range. *Aim:* The aim of this study is to evaluate whether constructing a long and narrow pouch can decrease the incidence of early and late dumping after laparoscopic proximal gastric bypass and to evaluate the likely impact of such a long and narrow pouch on the weight loss rates. *Patients and methods:* The study included 79 morbidly obese patients who received primary LPGBRY for treatment of their morbid obesity. They were divided into two groups; 42 patients who received LPGBRY with a long and narrow pouch (the [LN] group), and 37 patients who received LPGBRY with a classic globular pouch (the [G] group). Their 6 and 12 months' percentage of excess weight loss (%EWL) were recorded. Also, one year after surgery, all patients were required to fill in an Arabic translation of the Sigstad dumping score questionnaire, followed one hour later by an Arabic translation of the Arts score symptoms of late dumping, only if they scored 7 or more. *Results:* No significant differences were found in the %EWL between both groups. In the Sigstad questionnaire, the most commonly recorded symptoms were the need to lie down and frequent eructation, followed by dizziness, and distension. Frequent eructation was significantly higher in the [LN] group, while dizziness and palpitation were significantly more common in the [G] group ($p < 0.05$). Similar over all rates of dumping were observed in both groups ($p > 0.05$). Half the dumping patients in group [G] had late dumping symptoms. The incidence of late symptoms in the [G] group was significantly higher than in the long and narrow pouch [LN] group ($p < 0.05$). *Conclusion:* Long and narrow pouches in LPGBRY achieve similar weight loss rates as in the classic globular pouches. Constructing a long and narrow pouch produces similar overall dumping rate, but added significantly more eructation, less dizziness, less palpitation and less late dumping symptoms when compared to the classic globular pouches.

Keywords: Laparoscopic Proximal Gastric Bypass, Long and Narrow Pouches, Classic Globular Pouches, Weight Loss and Dumping

1. Introduction

Laparoscopic proximal gastric bypass Roux-en-Y (LPGBRY) has been regarded for a long time as the gold

standard treatment for morbid obesity and its comorbidities. [1] With the presence of the newer strong options, like the gastric sleeve and the mini gastric bypass, refinements in the technique are continuously taking place to improve its

outcomes.

Many factors are at play to govern the outcome after LPGBRY, including anatomical, hormonal emotional, dietetic and social factors. [2] Pouch and Roux limb configurations are at the heart of the anatomical considerations during the procedure. Pouch size has been researched in many studies. Currently, small volume pouches (<20ml), or micro pouches, are the choice for many surgeons, and variation in pouch size (within the limits of micro pouches) is no longer a prime factor in weight loss. [3] However, the pouch configuration, rather than its size, has been reported to alter the flow rate within, and hence the dumping effect after the LPGBRY. [4]

The exact mechanism of dumping is not fully understood, however, different mechanisms are involved in the etiology of early and late dumping. After LPGBRY, early dumping results from the reduced stomach volume, which results in rapid emptying of food into the small bowel. This leads to two main effects; the presence of large amount of hyperosmolar content in the small bowel, which leads to shift of fluid from the intravascular to the intestinal compartment. [5] And the release of vasoactive agents as vasoactive intestinal peptide (VIP), gastrin inhibitory polypeptides (GIP), GLP1, neurotensin, insulin and glucagon (the last two have direct effect on plasma glucose level). [6, 7] The combined effect of both mechanisms leads to decrease in the intravascular volume, resulting in tachycardia and the other vasomotor manifestations, distension and dis-coordinated bowel motility. [8]

On the other side, late dumping is directly related to the increased insulin release, as a consequent of dumping of high carbohydrate content into the small bowel and the resulting hypoglycemia. [6, 9] This has been shown to be an incretin-related effect, mediated mainly by the gastric inhibitory polypeptide and GLP-1 which have been shown to increase after LPGBRY. [10, 11]

It is logical to assume that the more rapid the flow rate in the gastric pouch, the more the early and late dumping symptoms. Although many factors may be involved in the flow rate within the gastric pouch, as its distensibility, peristalsis, antiperistalsis and outlet size, the diameter of the gastric pouch is one major player here, as has been shown by Capella et al. [4] The application of Poiseuille law on the gastric pouch showed that pouches of 1-cm diameter and 13-cm length are needed to deliver the same amount of fluid as a pouch of 2-cm diameter and 3.25-cm length. [4] The transport of the material through a narrow pouch is likely to be slower and produce a longer sensation of fullness than a short and wide pouch. [12]

Capella and his colleagues showed also that La Place's law suggests that a pouch with diameter of 1 cm will dilate only 50% as much as a pouch with a 2 cm diameter. As a pouch dilates, its restrictive capacity diminishes and its effect on weight loss decreases. [4]

The presence of early or late dumping symptoms has been evaluated by using different scoring systems. Two of the commonly used are the Sigstad and the Arts scores. [13] the Sigstad scoring system has been validated in the post

bariatric surgery assessment, while the Arts Scoring system is designed to differentiate between early and late dumping. [14].

2. Aim

The aim of this study is to evaluate whether constructing a long and narrow pouch can decrease the incidence of early and late dumping after laparoscopic proximal gastric bypass and to evaluate the likely impact of such a long and narrow pouch on the weight loss rates.

3. Patients and Methods

This is a prospective study. Initially, 93 morbidly obese patients were recruited. No patients for re-interventions were included in this study. However, the data of 79 morbidly obese patients were finally analyzed, excluding those who did not attend at least 12 months of follow up, as well as 3 patients, who suffered postoperative complications (one anastomotic leak and two anastomotic strictures) that were thought to change the pouch flow rates under study here. The patients received LPGBRY for treatment of their morbid obesity in the period between September 2014 and September 2015. Two independent teams were involved, each performed only one of the studied techniques in the study. Thus, the recruited patients included two groups; in the first group, 42 patients received LPGBRY with a long and narrow pouch (the [LN] group), and in the second group, 37 patients received LPGBRY with a classic globular pouch (the [G] group). The surgery was performed in Tanta University hospital, Alexandria university hospital and their affiliated hospitals.

All patients had a standardized work-up prior to surgery including: general, bariatric co-morbidity and dietetic history taking in addition to general and eating disorders psychological analysis. Blood tests for general fitness and background endocrinal work up were performed. Cardiac and pulmonary work up were performed as needed as well as upper endoscopy.

The long & narrow pouch [LN] group included 33 females and 9 males. Their age ranged between 24 and 52 years (average 34.5 years) and the preoperative Body mass index (BMI) ranged between 40.3 and 56 kg/M² (average 44.3 kg/M²). The Globular pouch [G] group included 30 females and 7 males. Their age ranged between 22 years and 54 years (average 32 years) and the preoperative BMI ranged between 40 and 58 kg/M² (average 45.2 kg/M²), table (1). The demographic data showed no statistical differences between the groups (p>0.05).

Table 1. Patients' demographics in both groups. (p<0.05 = statistically significant).

	Long & narrow pouch [LN]	Globular pouch [G]	P
Number of females	33	30	0.63
Number of males	9	7	0.23
Age (mean/SD)	34.5 (8.3)	32 (9.2)	0.53

For all patients, 5 ports approach was adopted. The lesser omentum was dissected in all cases with creation of a tunnel around the lesser curve to reach the lesser sac to spare the vagal branches. A micro pouch (< 20 ml) was created in all cases. The limbs lengths were constructed with the same fashion, 70 cm biliary limb and 180 cm alimentary limb. The gastrointestinal anastomosis was constructed for all by using 30mm blue cartridge.

Pouch configuration was constructed according to the allocated group. In the long & narrow pouch [LN] group, the stomach was transected 8 cm below the gastro-esophageal junction on the lesser curvature side with a 45 mm blue cartridge, and vertical transection was performed 3 cm from the lesser curve edge, using serial 60 mm blue cartridges around a 36 Fr bougie, extending until a point just lateral to the gastro-esophageal junction; thus creating a pouch of nearly 16 cc. in size. In the globular pouch [G] group, the transection was performed 4 cm below the gastro-esophageal junction on the lesser curvature with a 45 mm blue cartridge, and vertical transection was performed 4 cm from the lesser curve edge (leaving 0.5 cm from the end transection point; the size of a tip of a grasper) and goes parallel to the lesser curvature line, using serial 60 mm blue cartridges extending up until an area close to the gastro-esophageal junction, thus creating a pouch of nearly 19 cc.in size.

Post operative care was standardized to all patients. On the second or early third postoperative day, all patient received an upper contrast study to document the pouch configuration and exclude leaks. Post operative contrast assessment of pouch configurations is shown in figure (1).

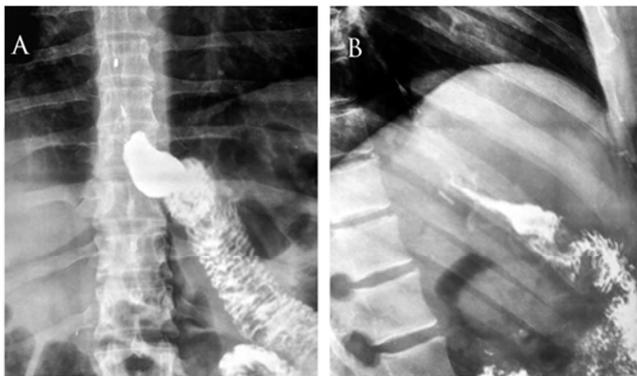


Figure 1. Postoperative contrast study showing (A) globular pouch and (B) long and narrow pouch configurations.

All patients were followed up for at least 12 months (median of 18 months). only their 6 and 12 months follow up data were analyzed regarding their percentage excess weight loss (%EWL) in this study. Twelve months after surgery, all patients were required to attend a clinic assessment, where they were required to ingest 50 ml of glucose (250 ml of 20% dextrose solution) and within 15 minutes answer a questionnaire including an Arabic translation of the Sigstad score symptoms sheet. The Sigstad scoring system document the occurrence of symptoms suggestive of the dumping syndrome, where, the patient or his attendant records the

presence or absence of different related symptoms. Every symptom is given a different weight and collectively scores equal tor greater than seven are considered diagnostic, Figure (2). [13]

Symptom or sign	Allocated value
Pre-shock or shock	+5
Loss of consciousness, fainting	+4
Will lie down or sit	+4
Dyspnea	+3
Physical fatigue, exhaustion	+3
Sleep, listlessness, blurred vision	+3
Palpitation	+3
Restlessness, agitation	+2
Dizziness, agitation	+2
Headache	+1
Feeling hot, sweating, paleness, clammy skin	+1
Nausea	+1
Abdominal distension, meteorism	+1
Borborygmi	+1
Eructation	-1
vomiting	-4

Figure 2. Sigstad score, symptoms, signs and allocated values.⁽¹³⁾

In our study, we added a degree to the symptoms based on a scale of 0 to 3, where 0 represents absence of the symptom, 1= mild, 2= moderate and 3= severe intensities. If patients scored 7 or more, diagnosis of postoperative dumping is made. To differentiate between early and late dumping, only those who scored 7 were required to fill in another questionnaire, 1 hour after their previous one, including an Arabic translation of the Arts score symptoms of late dumping only (Figure 3). The score uses a scale of four points; where 0 represents the absence of the symptom, 1 mild, 2 moderate and 3 severe intensities. [14]

Early dumping syndrome		Late dumping syndrome	
Sweating	0-3	Sweating	0-3
Blush	0-3	Tachycardia	0-3
Tontura	0-3	Hunger	0-3
Tachycardia	0-3	Somnolence	0-3
Abdominal pain	0-3	Unconsciousness	0-3
Diarrhea	0-3	Tremors	0-3
Swelling	0-3	Irritability	0-3
Nausea	0-3		

Figure 3. Arts score: signs and symptoms and intensity scoring.⁽¹⁴⁾

4. Statistical Analysis

The data of both groups were compared and statistical analysis was performed using fisher exact index, Chi square tests or student T tests when indicated with the help of SPSS pack Version 11.

5. Results

In our study, gender and age showed no statistical differences in both Long & narrow pouch [LN] and globular pouch [G] groups, with a majority of females in both group (78.6% in [LN] Vs 81.1% in [G]) ($P>0.05$), as shown in table

(1). Also, as shown in table (2), the preoperative BMI, % EWL at 6 months and at 12 months postoperatively showed no statistical difference between both groups, with a mean of 44.3 kg/m², 53.8% and 69.6% in the long and narrow pouch's patients versus 45.2 kg/m², 52.9% and 70.2% in the globular pouch 's patients ($P>0.05$)

Table 2. Preoperative BMI and percentage Excess Weight Loss (% EWL) in both groups. ($p < 0.05$ = statistically significant).

	Long & narrow pouch (LN)	Globular pouch (G)	p
Preoperative BMI (mean / SD)	44.3 (4.8)	45.2 (4.2)	0.72
%EWL at 6 months(mean/ SD)	53.8%	52.9%	0.65
%EWL at 12 months(mean/SD)	69.6%	70.2%	0.73

On analyzing the translated Sigstad dumping symptoms questionnaire, (as shown in table 3), shock and loss of consciousness were neither recorded subjectively by the patient, nor observed by the attending physician. In order of frequency, the most commonly recorded symptoms were the need to lie down (47.6% in the [LN] group and 51.4% in the [G] group) and frequent eructation (50% in the [LN] group Vs 37.8 % in the [G] group). While no statistical difference was found in the incidence of the need to lie down between the groups, frequent eructation was significantly more in the [LN] group ($p=0.03$).

The next common symptoms were dizziness (42.9% in [LN] group Vs 56.8% in [G] group), and dizziness (42.9% in the [LN] group Vs 45.9% in the [G] group). Presence of distension was found to be significantly more common in the [G] group.

Next symptoms in order of frequency in the [LN] and the

[G] groups respectively were: nausea (35.7% Vs 45.9%), palpitation (33.3% Vs 48.6%), abdominal cramp (28.6% Vs 29.7%), sleepiness (28.6% Vs 27%), fatigue (23.8% Vs 27%), sweating (23.8% Vs 27%), vomiting (23.8% Vs 24.3%) and headache (19% Vs 21.6%) as shown in table (3). Statistically, only palpitation was significantly more common in the [G] group ($P=0.03$).

The least recorded symptoms were dyspnea (4.8% in the [LN] group Vs 8.1 in the [G] group) and restlessness (9,5% in the [LN] group Vs 13.5% in the [G] group). No statistical differences were found in either symptom frequency in both groups ($P>0.05$).

Although more severe symptoms were recorded in the [G] group regarding the need to lie down, fatigue, sleepiness, headache and distension, no statistical differences were observed in between the groups in these symptoms as shown in table (3).

Table 3. Sigard dumping symptoms ' questionnaire in general in long & narrow Vs globular pouches. (* = statistically significant).

Symptom/sign	Long narrow & pouch (LN) (no.= 42) (No/%)				Globular pouch (G) (no.= 37) (No/%)				p
	none	mild	moderate	severe	none	mild	moderate	severe	
Shock	42 100%	0 0%	0 0%	0 0%	37 100%	0 0%	0 0%	0 0%	0.99
Loss of consciousness	42 100%	0 0%	0 0%	0 0%	37 100%	0 0%	0 0%	0 0%	0.99
Lie down	22 52.4%	14 33.3%	5 11.9%	1 2.4%	18 48.6%	13 35.1%	4 10.8%	2 5.4%	0.29
Dyspnea	40 95.2%	2 4.8%	0 0%	0 0%	34 91.9%	2 5.4%	1 2.7%	0 0%	0.76
Fatigue	32 76.2%	5 11.9%	5 11.9%	0 0%	27 73%	4 10.8%	5 13.5%	1 2.7%	0.63
Sleepiness	30 71.4%	6 14.3%	5 11.9%	1 2.4%	27 73%	5 13.5%	3 8.1%	2 5.4%	0.74
Palpitation	28 66.7%	11 26.2%	2 4.8%	1 2.4%	19 51.4%	12 32.4%	4 10.8%	2 5.4%	0.03*
Restlessness	38 90.5%	2 4.8%	1 2.4%	1 2.4%	32 86.5%	2 5.4%	2 5.4%	1 2.7%	0.62
Dizziness	24 57.1%	8 19%	8 19%	2 4.8%	16 43.2%	11 29.7%	7 18.9%	3 8.1%	0.04*
Headache	34 81%	5 11.9%	2 4.8%	1 2.4%	29 78.4%	5 13.5%	1 2.7%	2 5.4%	0.62
Hotness/ sweating	32 76.2%	8 19%	2 4.8%	0 0%	27 73%	8 21.6%	2 5.4%	0 0%	0.58
Nausea	27 64.3%	7 16.7%	8 19%	0 0%	20 54.1%	9 24.3%	8 21.6%	0 0%	0.07
Distension	24 57.1%	11 26.2%	6 14.3%	1 2.4%	20 54.1%	8 21.6%	7 18.9%	2 5.4%	0.66
Abdominal cramps	30 71.4%	6 14.3%	6 14.3%	0 0%	26 70.3%	6 16.2%	5 13.5%	0 0%	0.82

Symptom/sign	Long narrow & pouch (LN) (no.= 42) (No/%)				Globular pouch (G) (no.= 37) (No/%)				p
	none	mild	moderate	severe	none	mild	moderate	severe	
Eructation	21 50%	15 35.7%	6 14.3%	0 0%	23 62.2%	10 27%	4 10.8%	0 0%	0.03*
Vomiting	32 76.2%	8 19%	2 4.8%	0 0%	28 75.7%	6 16.2%	3 8.1%	0 0%	0.31

Table 4. Late dumping symptoms in patients scoring more than 7 in the early dumping questionnaire in both groups. (* = statistically significant).

Symptom/sign	Long & narrow pouch (LN) (No.=13) (No/%)				Globular pouch (G) (No.=12) (No/%)				p
	None	mild	moderate	severe	none	mild	moderate	severe	
Hotness/ sweating	10 76.9%	3 23.1%	0 0%	0 0%	6 50%	5 41.7%	1 8.3%	0 0%	0.04*
Palpitation	9 69.2%	3 23.1%	1 7.7%	0 0%	6 50%	3 25%	3 25%	0 0%	0.05*
Hunger	10 76.9%	2 15.4%	1 7.7%	0 0%	6 50%	6 50%	0 0%	0 0%	0.03*
Sleepiness	9 69.2%	4 30.8%	0 0%	0 0%	6 50%	5 41.7%	1 8.3%	0 0%	0.04*
Loss of consciousness	13 100%	0 0%	0 0%	0 0%	12 100%	0 0%	0 0%	0 0%	-
Tremors	11 84.6%	2 15.4%	0 0%	0 0%	9 75%	3 25%	0 0%	0 0%	0.52
Restlessness	9 69.2%	3 23.1%	1 7.7%	0 0%	8 66.7%	3 25%	1 8.3%	0 0%	0.72

On applying the Sigstad score on our studied patients, out of 42 patients in the [LN] group, 13 patients scored 7 or more, representing 30.95% rate of true dumping at 1 year postoperatively. While in the [G] group, 12 out of 37 scored 7 or more, representing a similar rate of 32.43% in this group. No statistical difference was observed in the over all rate of dumping in both groups ($P>0.05$). As mentioned before, only those who scored 7 or more were considered to have true dumping symptoms, and were required to complete the second questionnaire to evaluate the rate of late dumping. As shown in table (4), no patients recoded loss of consciousness, nor was it observed by the attending physicians. The incidence of tremors and restlessness were more observed in the [G] group (25% and 33.3%) than in the [LN] group (15.4% and 30.8%) but the difference showed no statistical significance, ($P>0.05$). In the globular pouch [G] group, an over all of 50% of the early true dumping patients reported late dumping symptoms as sweating, palpitation, Hunger and sleepiness (17.2% of the whole studied group). The incidence of these late dumping in the [G] group was significantly higher than in the long and narrow pouch [LN] group in all these symptoms (23.1%, 30.8%, 23.1% and 30.8% respectively), ($p<0.05$).

6. Discussion

Dumping syndrome is a well known sequel after gastric and esophageal surgery and has been estimated to occur in up to 40% of cases after bariatric procedures as the proximal gastric bypass Roux –en-Y LPGBRY. [15] Both early and late dumping has been recorded after LPGBRY, probably resulting from the rapid delivery of hyperosmolar food and intra intestinal fluid shift as well as gastrointestinal hormonal

release in case of early dumping and due to insulin release with subsequent hypoglycemia (due to the incretin-related effect mediated by the gastric inhibitory polypeptide and GLP1) in case of late dumping. [6-10] Dumping alters the patient's dietary behavior and may result in weight loss after gastric surgery [16], but whether this is beneficial to the weight loss mechanism after LPGBRY is doubtful, as many studies had shown clearly that weight loss after LPGBRY did not depend on the dumping effect. [10] In fact, dumping should be regarded as a downstage in the patient's life style, and every possible effort to avoid it should be considered.

As mentioned earlier, studies on pouch configuration suggested that in LPGBRY, a long and narrow pouch slows the nutrients flow rate into the small bowel. [4] This effect might, in theory, decrease the incidence of dumping. This should be beneficial provided that such a pouch can achieve the same weight loss as in the classic LPGBRY. Therefore, in this prospective study, the data of 79 morbidly obese patients who underwent primary LPGBRY was analyzed. The recruited patients included two demographically similar groups; in the first group, 42 patients received LPGBRY with a long and narrow pouch (the [LN] group), and in the second group, 37 patients received LPGBRY with a classic globular pouch (the [G] group). Each group was operated upon by an independent surgical team, aiming to evaluate whether constructing a long and narrow pouch can decrease the incidence of early and late dumping after LPGBRY and to evaluate the likely impact of such a long and narrow pouch on the weight loss rates.

In our study, the % EWL at 6 months and at 12 months postoperatively showed no statistical differences between both groups, with a mean of 53.8% and 69.6% in the long and narrow pouch's patients versus 52.9% and 70.2% in the globular pouch 's patients ($P>0.05$). The %EWL of a long

and narrow pouch has been reported to be as high as 77% on the long term in Capella et al study. However, their technique included a banded pouch outlet, to prevent outlet dilatation. [17] In the literature, classic globular pouches %EWL ranged between 62%, in the un-banded, to 75% in the banded LPGBRY. [18, 19]

In this study, one year after the LPGBRY, dumping was scored using an Arabic translation of the Sigstad questionnaire. Shock and loss of consciousness were neither recorded subjectively by the patient, nor observed by the attending physicians. In order of frequency, the most commonly recorded symptoms were the need to lie down (47.6% in the [LN] group and 51.4% in the [G] group) and frequent eructation (50% in the [LN] group Vs 37.8 % in the [G] group). Only frequent eructation was significantly more in the [LN] group ($p=0.03$). It appears that the long and narrow pouch decreases air flow too as it does for food and fluids, the longer and more pronounced eructation spills could be observed. This effect is similar to that found in the long pouches in other bariatric procedures as the gastric sleeve operation. [20]

The next common symptoms were dizziness (42.9% in [LN] group Vs 56.8% in [G] group), and distension (42.9% in the [LN] group Vs 45.9% in the [G] group). Other symptoms were observed as shown in table 3. Although more moderate and sever symptoms were recorded in the [G] group regarding the need to lie down, fatigue, sleepiness, headache and distension, statistically, only dizziness and palpitation were significantly more common in the [G] group ($P=0.03$). in general, constructing a long and narrow pouch added more eructation, less dizziness and less palpitation in our patients. This can be explained by the faster passage of the nutrients to the small bowel with more fluid shift, but this is still to be proven. On applying the Sigstad score, 30.95% in the [LN] group, and 32,43% in the [G] group scored 7 or more (true dumping), however, no statistical difference was observed in the over all rate of dumping in both groups ($P>0.05$). The rate of early and late dumping after LPGBRY in the literatures varies, in Ramadan et al study, constructing globular pouches showed a 18.78% rate of dumping, 6 months after surgery. [21] However, such low rates might increase on applying the Sigstad score as in Loss et al study [22], where an initial reporting of 44% of dumping increased to 76% after applying the Sigstad score.

On the other side, an over all of 50% of the true early dumping patients in group [G] reported late dumping symptoms as sweating, palpitation, Hunger and sleepiness (17.2% of the whole studies group). The incidence of these symptoms in the [G] group was significantly higher than in the long and narrow pouch [LN] group (23.1%, 30.8%, 23.1% and 30.8% respectively), ($p<0.05$). Late dumping in the literature after bariatric surgery has been reported to be around 25% up to 2 years after LPGBRY. [14] In our study, creating long and narrow pouch resulted in statistically less sweating, palpitation, hunger and sleepiness. It seems that the slower flow rates in the long and narrow pouch might induce less incretin-related effect, thus, producing less

hypoglycemia than in the globular pouches. This explanation will need further proof and we intend to follow the gastric Inhibitory polypeptides and GLP1 levels in our late dumpers to confirm their role in late dumping in our patients.

7. Conclusion

Our results showed that Long and narrow pouches in LPGBRY achieved similar weight loss rates as in the classic globular pouches. Constructing a long and narrow pouch added significantly more eructation, less dizziness, and less palpitation but similar overall early dumping rates compared to the classic globular pouches. It also resulted in statistically less late dumping symptoms as sweating, palpitation, hunger and sleepiness.

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