Incidence of Dumping Syndrome after Sleeve Gastrectomy, Roux-en-Y Gastric Bypass and One-Anastomosis Gastric Bypass

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Research Article

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Abstract

Background: Dumping syndrome (DS) is an important but often missed problem occurring after bariatric surgery. It is believed that gastric bypass procedures like Roux-en-Y Gastric Bypass (RYGB) and One-Anastomosis Gastric Bypass (OAGB) are more likely to cause DS than the pylorus-preserving Sleeve Gastrectomy (SG). The aim of this study was to evaluate the incidence of DS in patients undergoing SG, RYGB and OAGB.

Methods: A retrospective clinical study with additional phone interviews of 180 morbidly obese patients (130 females; 72.2%) undergoing SG (n=50), RYGB (n=53) and OAGB (n=77) in our clinic during 2016 - 2018 was performed. Clinical and demographic data were assessed. The incidence of dumping syndrome was evaluated using validated Sigstad Score.

Results: Information about the occurrence of dumping symptoms and patient satisfaction was obtained from 127 patients; 53 could not be reached by phone. Median follow-up was 20.0 ± 11.4 months. Significant differences between the surgical procedures were found for the duration of surgery, complications, incidence of DS and satisfaction postoperatively. DS occurred in 15.6% after SG, in 56.4% after RYGB and in 42.9% after OAGB. While SG showed the shortest operative time with 66.5 ± 25.3 minutes and highest patient satisfaction, the lowest complication rate was observed after OAGB with 5.2%. The RYGB group reported the longest duration of surgery with 121.0 ± 28.9 minutes, most complications (17.0%), and lowest patient satisfaction.

Conclusion: The present results showed a clear superiority of SG regarding both perioperative results and incidence of DS compared to RYGB and OAGB and may impact clinicians and patients in their choice of procedure.

Introduction

The steadily increasing prevalence of people suffering from obesity has developed into one of the greatest public health challenges of the 21st century. Since the 1980s, prevalence has tripled in many countries in the WHO European Region causing various physical disabilities and psychosocial problems [1]. Observational studies have shown that in cases of obesity, a conservative approach leads to sustainable success in only very few cases. Therefore bariatric surgery remains the most effective therapeutic option for achieving permanent weight reduction and metabolic improvements [2].

Today, the offers range from simple restrictive models up to complex operations, which radically intervene in the gastrointestinal tract and change it in structure and function [3]. The focus here is primarily on causing malabsorption. This leads to deficiency symptoms in many cases, which must be prevented and treated sufficiently. Beside the mechanistic model of restriction and malabsorption, metabolic operations change the perception of hunger and satiety by altering the secretion of gut hormones (e.g. peptide YY, glucagon-like peptide-1, ghrelin, leptin) and adipocytokines and reestablishing the diversity of gut microbiota [4]. Complications that can negatively affect the postoperative course are

bleeding, ulcers, stenoses and dumping syndrome (DS). DS is a very common and often self-induced problem after bariatric surgery. This complication has been known for many decades and has been observed increasingly after operations involving gastric resection with reconstruction, although it is frequently underdiagnosed. With the rise of bariatric surgery, dumping symptoms have increasingly received attention and have become the focus of interest in metabolic procedures. There are two types of DS - early and late dumping which include gastrointestinal and vasomotor symptoms following meal intake. Early dumping usually occurs within 30 minutes of food ingestion. High-osmolarity foods (e.g. high-sugar foods) cause an osmotic overload after bypassing much of the stomach undigested as they enter the small intestine. This hyperosmolality leads to fluid shifts from the circulation to the intestinal lumen, thereby diluting the ingested food. Together with a vagal response and hypersecretion of gastrointestinal hormones, such as neurotensin and vasoactive intestinal peptide, hypotension, dizziness, lightheadedness and a very unpleasant feeling of fatigue and exhaustion are induced in the patient. Abdominal symptoms include early satiety, bloating, pain, diarrhea, nausea, cramps, flatulence, and borborygmi. Late dumping occurs 1-3 hours postprandial and often presents a challenge in both diagnosis and treatment. The underlying pathophysiologic mechanism in late dumping is neuroglycopenia (NGP) caused by reactive hypoglycemia. This manifests mainly in adrenergic symptoms such as agitation, anxiety, sweating, tremor, tachycardia and palpitations. If left untreated, a NGP can even lead to coma with lethal outcome [5,6]. The most common bariatric procedures currently performed are SG and RYGB. The incidence and intensity of DS is related to the type of gastric resection and occurs more frequently after RYGB surgery compared to SG [7]. In the last decade, due to very promising results, the OAGB has been implemented more frequently [8]. There are indications that the OAGB is superior to the RYGB in terms of the incidence of postoperative dumping syndrome [9]. However, data directly comparing these procedures is limited. Therefore, this analysis takes the opportunity to compare all three procedures and to evaluate the incidence of DS in our own patient collective.

Materials And Methods

Our study included 180 consecutive patients who had undergone SG (n=50), RYGB (n=53) and OAGB (n=77) at the Clinic for General and Visceral Surgery at the Kepler University Clinic Linz between January 1, 2016 and December 31, 2018. Retrospectively, the clinical and demographic data of the study participants, surgery duration and incidence of operative complications were taken from the hospital information system and collected in the obesity database *Mazimoi ODS* (Bariatric Patient Documentation and Data Analysis). 127 of the patients were interviewed by phone in October 2019; 53 patients could not be reached by phone. A standardized questionnaire was filled out for each patient, recording responses on postoperative dumping symptoms and their satisfaction with the procedure. The Sigstad Score was used to evaluate dumping. We did not perform any provocative tests in order to assess dumping symptoms in a way which is more relevant to daily practice.

Individual patient satisfaction was assessed by giving a school grade (1=very good, 2=good, 3=satisfactory, 4=sufficient, 5=not sufficient) and asking whether the patient would undergo the intervention again. Patient inclusion for bariatric surgery was based on the criteria of the National

Institutes of Health Development Panel (Body Mass Index (BMI) >40 kg/m² or BMI >35 kg/m² with at least one obesity-associated comorbidity) [2]. Patients who have not met the NIH criteria or had incomplete preoperative clarification were excluded. Pregnancy was also not compatible with bariatric surgery. Patients who had previous abdominal surgery or had already undergone bariatric surgery before (e.g. gastric band), were also enrolled in the study. Further exclusion criteria for admission to the study were an incomplete follow-up protocol and any other bariatric procedure except SG, RYGB and OAGB. Preoperatively all candidates were evaluated by a multidisciplinary medical unit and underwent preoperative nutritional consultation and psychological, and comprehensive medical evaluations. A detailed assessment was performed of their general condition, comorbidities, risk factors, mental status, motivations for bariatric surgery, compliance and ability to adhere to a postoperative regimen. Biochemical and radiological studies (chest x-ray, upper GI series) as well as endocrine and cardiopulmonary assessment, were performed. The study was conducted after approval from the ethics committee and Institutional Review Board (Ethics committee protocol number: 1025/2020).

Variables

All variables were analysed at baseline (perioperative values) and included gender, age, BMI, preoperative weight, type of surgery, operative time and complications. Patients were evaluated 20.0 ± 12.1 months after SG, 20.0 ± 12.1 months after RYGB and 20.0 ± 10.7 months after OAGB during a phone interview which included filling out a standardized questionnaire after patient's consent. Incidence of dumping syndrome and satisfaction were monitored and possible association between diabetes and dumping and satisfaction and dumping was tested. Complications were defined as minor in cases where no surgical reintervention was necessary (Clavien Dindo grade 1 or 2). Complications were defined as major when patients had to undergo surgical reexploration (Clavien Dindo grade 3 or higher). Operation time was defined as the beginning of the skin incision to completion of the surgical dressing. Sigstad Score was used to evaluate dumping (Table 1). A score of 7 and above was considered positive for dumping syndrome. Informed consent was obtained from all of the patients.

Statistical analysis

All data was evaluated using IBM SPSS Statistics 24.0 (SPSS Inc. Chicago, IL, USA) and then processed and graphically displayed in Microsoft Excel. By means of descriptive statistics, mean values, standard deviations, medians and ranges were calculated. An intention to treat approach as well as a per-protocol approach has been taken. All data of continuous variables were checked for normal distribution using Kolmogorov-Smirnov-test with Lilliefors significance correction. Comparisons (SG vs. RYGB vs. OAGB) of variables with normally distributed data without different variances were performed by a parametric analysis of variance (ANOVA). For comparisons of all other continuous variables and of variables measured on ordinal scales a non-parametric analysis of variance (Kruskal Wallis test) was used. Data of categorical variables were compared by the exact chi-square test. The absolute and relative frequencies

of individual parameters were compared using frequency tables and displayed in crosstabs. Correlations were tested using Fisher's exact test. A significance level of 0.05 was applied to all statistical tests.

Operation techniques

In all patients standardized operation techniques were used and all procedures were performed laparoscopically under general anesthesia by the same surgeon. The operations were either primary bariatric surgery for 157 patients (87.2%) or reoperations following gastric banding in 23 patients (12.8%). Anastomosis integrity was verified after every procedure with an intraoperative endoscopic pneumatic-water test.

SG: Five ports were used. Three 12-mm ports were located in the epigastric, right hypochondriac and left lumbar region. A 5-mm port was placed subxiphoideal and a 15-mm port in the right lumbar region. A longitudinal resection from the angle of His to approximately 6cm orally to the pylorus was performed using a linear stapler (iDrive® with Tri-staple cartridges, Medtronic, USA). A 34-Fr bougie was used for calibration of the gastric tube and inserted along the lesser curvature.

RYGB: 5 ports were placed. One in the right hypochondriac region (12-mm), left hypochondriac region (12-mm), epigastrium (12-mm), subxiphoideal (5-mm), and left paraumbilical (12-mm). A gastric pouch was performed, calibrating it using a 34-Fr bougie, with a linear stapler (iDrive® with Tri-staple cartridges, Medtronic, USA). A 140-cm biliary limb and a 80-cm alimentary limb were performed. Gastrostomy was done using a 30-mm linear stapler. The enterotomies and gastrotomies were sutured with Vicryl 3/0 SH. Petersen’s space was always closed.

OAGB: 5 ports were placed in the same positions as in RYGB. A long and slim gastric pouch, calibrated with a 34-Fr bougie, was constructed. Termino-lateral gastrojejunal anastomosis with 30-mm linear stapler (iDrive® with Tri-staple cartridges, Medtronic, USA) was performed. The afferent loop was sutured up to the long stomach pouch with three Prolene sutures (anti-reflux sutures) and the draining loop is sutured to the antrum of the remnant stomach with another Prolene 2.0 suture with extracorporeal slip knots. The enterotomies and gastrotomies were closed with continuous barbed suture V-Loc 2/0 (Medtronic, USA). The biliopancreatic limb length ranged between 140 and 180 cm. We choose not to close the Petersen’s space when performing OAGB.

Results

Between January 2016 and December 2018, a total of 180 patients received bariatric surgery. 27.8% received SG (n=50), 29.4% RYGB (n=53) and 42.8% (n=77) OAGB. After median 20.0 ± 11.4 months 127 patients were contacted by phone; 53 patients could not be reached and were excluded from the analysis of dumping syndrome and postoperative satisfaction. Patient demographics are shown in table 2.

Complications are depicted in Table 3. There were no deaths. The overall complication rate was 8.9% (n=16). There was no conversion to open surgery. Early major complications requiring reoperation occurred in 7 patients (3.9%). Four patients after RYGB, two patients after SG and one patient after OAGB and included stapler line failure, internal hernia, bleeding and anastomotic failure. Overall complication rate after SG was 6.0% (n=3), 17.0% (n=9) after RYGB, and 5.2% (n=4) after OAGB ($p<0.05$). All patients recovered well after the treatment.

The overall incidence of DS in our study population was 40.2% (n=51). We reported 5 cases (15.6%) of DS after SG, 22 cases (56.4%) after RYGB and 24 cases (42.9%) after OAGB ($p<0,01$) (Figure 1). There was no significant difference in DS between RYGB and OAGB ($p=0.216$). The median Sigstad Score obtained was 0.0 ± 4.7 for SG, 10.0 ± 8.1 for RYGB and 4.0 ± 8.9 for OAGB ($p<0.01$) (Table 4).

The distribution of diabetics in the three groups was evaluated and compared with the incidence of dumping (Table 4). In total, 26.0% of the 127 patients (n=33) suffered from DM type two. 27.5% (14/51) reporting symptoms of dumping were also diabetics. There was no correlation between DM and DS. Individual patient satisfaction was rated best in the SG group and achieved a grade point average of 1.13 followed by OAGB with 1.25 and RYGB with 1.72 ($p<0,01$). 96.9% after SG, 94.6% after OAGB and 76.9% after RYGB stated they would undergo surgery again at any time ($p<0,05$). Overall satisfaction after bariatric surgery was 1.36 with 89.8% not regretting their surgery.

A statistically significant correlation between the occurrence of dumping and perceived satisfaction was shown. This was reflected both in the school grades ($p<0.01$) and in the response to the question of whether they would undergo the same bariatric procedure again ($p<0.01$). Thus, 66.7% of patients without dumping rated the procedure performed as "very good," whereas this was the case in 33.3% of patients with dumping. "Sufficient" and "not sufficient" was only answered by patients with dumping. Furthermore, 97.3% of the patients without dumping stated that they would be willing to undergo surgery again, while 82.0% of those with dumping could imagine undergoing surgery again.

Discussion

Starting with simple restrictive methods, bariatric surgery has now arrived at complex interventions with significant metabolic implications. Observations of numerous surgeries have contributed to a better understanding of the physiology of the gastrointestinal tract and in this way revolutionized many treatment approaches. The final breakthrough finally came with the introduction of laparoscopy. Morbidity and mortality were reduced to such an extent that bariatric surgery became a safe and effective weapon in the fight against obesity.

The Sigstad score represents a useful tool in the evaluation of dumping syndrome. The diagnosis of dumping is primarily clinical and requires a detailed history and examination. If the diagnosis is doubted an Mixed Meal-Test can be helpful in order to trigger symptoms of early dumping [10]. In the treatment of DS, a stepwise approach is recommended. This includes dietary adjustment, pharmacologic interventions

and finally surgical re-interventions or continuous tube feeding. Dietary modifications are the main base of therapy and focus on the reduction of simple carbohydrates and giving preference to high protein foods. Patients are instructed to reduce their portions, chew slowly and not drink liquids for half an hour after eating a solid meal. Also milk and diary products should be avoided. If these diet modifications do not lead to improvement, Somatostatin analogues such as octreotide and pasireotide are available. They have been shown to retard gastric emptying, slow bowel transit and inhibit the release of vasoactive peptides. However, these carry risk of side effects such as diarrhea, nausea, and steatorrhea [7]. Other medical treatment options include acarbose, verapamil, diazoxide, glucagon-like peptide-1 (GLP-1) analoga and GLP-1 receptor antagonists [11–13]. Surgical intervention is reserved only for a small group that does not respond to the measures mentioned above and report a significant reduction in quality of life. Options that can be offered here are the insertion of a gastric tube into the remnant stomach, a restriction of the gastric outlet and a reversal operation. It is important, especially in the case of a reverse operation, that the patients are informed about possible weight regain and worsening of comorbidities [14]. The incidence of DS correlates with the type of gastrectomy performed. Accordingly, a higher incidence of DS is observed in patients after total gastrectomy compared to proximal gastrectomy. DS has been proven to occur in 15 to 70% after gastric bypass procedures, with symptoms improving over time [15,16]. Kefurt et. al reported hypoglycemic episodes in 75% of patients after RYGB using continuous glucose monitoring, while a Mixed Meal-Test indicated hypoglycemia in 29% [17]. In addition, however, DS is also observed in procedures that involve only partial gastric resection, such as SG. Although this surgery is expected to have a lower risk of DS, two prospective studies reported DS rates of up to 40% 6-12 months after SG [18]. The aim of our study was to find the incidence of DS among patients after SG, RYGB and OAGB only by evaluating clinical symptoms and using the Sigstad score. Patient demographics, operative data and complication rates were similar to those reported in the literature. SG was associated with a significantly lower risk for DS compared to RYGB and OAGB ($p<0,01$). It is believed that DS is less likely to occur after SG due to preservation of the pyloric sphincter [16]. The overall incidence of DS in our study population was 40.2%. We were not able to show a significant superiority regarding DS for OAGB compared to RYGB as reported in literature, although indicating a slight tendency in favor of OAGB. Further data collection and a larger sample size would be needed to confirm these finding. In our study there was no correlation between the prevalence of DM and DS. While SG scored better in many parameters, reflux und weight regain are still matter of discussion by many authors when looking on the long-term follow up. Felsenreich et al. found that EWL and symptomatic reflux impair patients' long-term quality of life after SG [19]. This observation should be taken into account when choosing the type of bariatric surgery for the individual patient. In order to clearly prove or disprove differences between the treatment groups, a larger study population and longer follow-up period are required. In addition, not all patients could be reached by telephone and were therefore not available for the evaluation of DS and postoperative satisfaction. The Sigstad Score was used to assess the incidence of DS. However, the assessment of symptoms is very subjective and may vary among patients. The use of continuous glucose monitoring systems would be an option to create a more comparable format. Furthermore, some of our patients had bariatric revisions as mentioned above, which in all cases were conversions from gastric banding to SG, RYGB and OAGB. These patients are known to be more prone to

surgical complications. Nevertheless, we did not evaluate them separately because we do not expect the incidence of DS to be increased by pre-operation. This could be a question of debate.

Conclusion

Significant differences between the surgical procedures in terms of operative time, dumping syndrome, complications and satisfaction were reported. Although any procedure which involves gastrointestinal resection or digestive system bypass includes the risk of developing DS, SG is associated with a significantly lower risk for DS than RYGB and OAGB. Considering our results, the superiority of SG compared to OAGB and RYGB was demonstrated in many parameters. Although RYGB is currently the most popular procedure in Austria, this study should serve as an opportunity to incorporate the presented results into the decision-making process for the most individually appropriate surgical procedure for the patient.

Abbreviations

BMI body mass index

DM diabetes mellitus

DS dumping syndrome

GLP-1 glucagon-like peptide-1

NIH National Institutes of Health

NGP neuroglycopenia

OAGB One-Anastomosis Gastric Bypass

RYGB Roux-en-Y Gastric Bypass

SG Sleeve Gastrectomy

Declarations

Disclosure Statement :The authors declare that they have no conflicts of interest.

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Conflicts of interest/Competing interests: The authors have no conflicts of interest to declare that are relevant to the content of this article.

Availability of data and material: The submitted work has not been published elsewhere in any form or language

Ethics approval: This retrospective study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The Ethics Committee of Johannes Kepler University Linz approved this study (IRB number 1025/2020). This study was a retrospective review that did not include patient identifiers, presented no more than minimal risk (including physical and psychological) to its research subjects.

Consent to participate: Verbal informed consent was obtained prior to the interview.

Consent for publication: All participants agreed verbally with the publication of the results. No (identifiable) personal data was published.

Author contributions: All authors contributed to the study conception and design. Material preparation and data collection were performed by Adisa Poljo. Statistical analysis was performed by Adisa Poljo. The first draft of the manuscript was written by Adisa Poljo and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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References

1. Giampaoli S, Vannucchi S. Obesity and diabetes, a global problem: what does recent data tell us? Ig E Sanita Pubblica. 2016;72(6):561–70.
2. Padwal R, Klarenbach S, Wiebe N, Birch D, Karmali S, Manns B, u. a. Bariatric surgery: a systematic review and network meta-analysis of randomized trials. Obes Rev. 2011;12(8):602–21.
3. Carbajo MA, Luque-de-León E, Jiménez JM, Ortiz-de-Solórzano J, Pérez-Miranda M, Castro-Alija MJ. Laparoscopic One-Anastomosis Gastric Bypass: Technique, Results, and Long-Term Follow-Up in 1200 Patients. Obes Surg. 2017;27(5):1153–67.
4. Pucci A, Batterham RL. Mechanisms underlying the weight loss effects of RYGB and SG: similar, yet different. J Endocrinol Invest. 2019;42:117–28.
5. Fujioka K. Follow-up of nutritional and metabolic problems after bariatric surgery. Diabetes Care. 2005;28(2):481–4.
6. Berg P, McCallum R. Dumping Syndrome: A Review of the Current Concepts of Pathophysiology, Diagnosis, and Treatment. Dig Dis Sci. 2016;61(1):11–8.

7. Ramadan M, Loureiro M, Laughlan K, Caiazzo R, Iannelli A, Brunaud L, u. a. Risk of Dumping Syndrome after Sleeve Gastrectomy and Roux-en-Y Gastric Bypass: Early Results of a Multicentre Prospective Study. Gastroenterol Res Pract. 2016:2570237
8. Melissas J, Stavroulakis K, Tzikoulis V, Peristeri A, Papadakis JA, Pazouki A, u. a. Sleeve Gastrectomy vs Roux-en-Y Gastric Bypass. Data from IFSO-European Chapter Center of Excellence Program. Obes Surg. 2017;27(4):847–55.
9. Rheinwalt KP, Plamper A, Rückbeil MV, Kroh A, Neumann UP, Ulmer TF. One Anastomosis Gastric Bypass-Mini-Gastric Bypass (OAGB-MGB) Versus Roux-en-Y Gastric Bypass (RYGB)-a Mid-Term Cohort Study with 612 Patients. Obes Surg. 2020;1230-1240
10. Kleij FGHVD, Vecht J, Lamers CBHW, Masclee AAM. Diagnostic Value of Dumping Provocation in Patients after Gastric Surgery. Scand J Gastroenterol. 1996;31(12):1162–6.
11. Abrahamsson N, Engström BE, Sundbom M, Karlsson FA. GLP1 analogs as treatment of postprandial hypoglycemia following gastric bypass surgery: a potential new indication? Eur J Endocrinol. 012;169(6):885–9.
12. Moreira RO, Moreira RBM, Machado NAM, Gonçalves TB, Coutinho WF. Post-prandial hypoglycemia after bariatric surgery: pharmacological treatment with verapamil and acarbose. Obes Surg. Dezember 2008;18(12):1618–21.
13. Spanakis E, Gragnoli C. Successful medical management of status post-Roux-en Y-gastric-bypass hyperinsulinemic hypoglycemia. Obes Surg. 2009;19(9):1333–4.
14. Van Beek AP, Emous M, Laville M, Tack J. Dumping syndrome after esophageal, gastric or bariatric surgery: pathophysiology, diagnosis, and management: Dumping syndrome. Obes Rev. 2016;18.
15. Takiguchi N, Takahashi M, Ikeda M, Inagawa S, Ueda S, Nobuoka T, u. a. Long-term quality-of-life comparison of total gastrectomy and proximal gastrectomy by Postgastrectomy Syndrome Assessment Scale (PGSAS-45): a nationwide multi-institutional study. Gastric Cancer Off J Int Gastric Cancer Assoc Jpn Gastric Cancer Assoc. 2014;18.
16. Ahmad A, Kornrich DB, Krasner H, Eckardt S, Ahmad Z, Braslow A, u. a. Prevalence of Dumping Syndrome After Laparoscopic Sleeve Gastrectomy and Comparison with Laparoscopic Roux-en-Y Gastric Bypass. Obes Surg. 2019;29(5):1506–13.
17. Kefurt R, Langer FB, Schindler K, Shakeri-Leidenmühler S, Ludvik B, Prager G. Hypoglycemia after Roux-En-Y gastric bypass: detection rates of continuous glucose monitoring (CGM) versus mixed meal test. Surg Obes Relat Dis. 2015;11(3):564–9.
18. Papamargaritis D, Koukoulis G, Sioka E, Zachari E, Bargiota A, Zacharoulis D, u. a. Dumping symptoms and incidence of hypoglycaemia after provocation test at 6 and 12 months after laparoscopic sleeve gastrectomy. Obes Surg. 2012;22(10):1600–6.
19. Felsenreich DM, Prager G, Kefurt R, Eilenberg M, Jedamzik J, Beckerhinn P, u. a. Quality of Life 10 Years after Sleeve Gastrectomy: A Multicenter Study. Obes Facts. 2019;12(2):157–66.

Tables

Table 1 Sigstad scoring system

Shock	+5
Desire to lie or sit down	+4
Fainting, syncope, unconsciousness	+4
Breathlessness, dyspnea	+3
Palpitation	+3
Weakness, exhaustion	+3
Sleepiness, drowsiness, apathy, falling asleep	+3
Restlessness	+2
Dizziness	+2
Nausea	+1
Headaches	+1
Feeling of warmth, sweating, pallor, clammy skin	+1
Abdominal fullness, meteorism	+1
Borborygmus	+1
Eructation	-1
Vomiting	-4

Table 2 Distribution of age, gender, preoperative anthropometric measures, follow up, operative time and complications between groups[a]

Characteristics	SG (n=50)	RYGB (n=53)	OAGB (n=77)	Total (n=180)	p-value[b]
Age (years)	42.5 ± 10.2	32.0 ± 9.3	45.0 ± 9.1	42.0 ± 10.8	< 0.001**
Females/males	29/21	41/12	60/17	130/50	0.03*
BMI (kg/m^2)	46.7 ± 8.0	43.8 ± 4.9	42.1 ± 5.1	43.2 ± 6.3	0.001**
Weight (kg)	130.0 ± 28.4	125.0 ± 21.1	122.0 ± 17.0	125.0 ± 22.6	0.02*
Follow-up (months)	20.0 ± 12.1	20.0 ± 12.1	20.0 ± 10.7	20.0 ± 11.4	0.970
Operating time (minutes)	66.5 ± 25.3	121.0 ± 28.9	99.0 ± 31.5	96.5 ± 34.0	< 0.001**
Complications	3/50 (6.0%)	9/53 (17.0%)	4/77 (5.2%)	16/180 (8.9%)	0.047*

BMI: body mass index

[a] Values are presented as mean ± one standard deviation

[b] *P < 0.05. **P < 0.01

Table 3 Complications other than DS after RYGB, SG and OAGB

Operation	Complication	Number of patients (n)	Treatment
SG (n=50)	Bleeding	2	Surgical
	Bradykardia with short-term asystole	1	CPR, drugs
RYGB (n=53)	G-J anastomotic ulcer	5	PPI
	Stapler line failure of the gastric remnant	1	Surgical
	Internal hernia	1	Surgical
	Bleeding	2	Surgical
OAGB (n=77)	G-J anastomotic failure	1	Endo-SPONGE®
	G-J anastomotic ulcer	3	PPI
Total (n=180)		16	

Table 4 Incidence of dumping syndrome and satisfaction

Characteristics	SG (n=32)	RYGB (n=39)	OAGB (n=56)	Total (n=127)	p-value[b]
Dumping syndrome (DS)	5 (15.6%)	22 (56.4%)	24 (42.9%)	51 (40.2%)	0.001**
Sigstad score	0.0 ± 4.7	10.0 ± 8.1	4.0 ± 8.9	4.0 ± 8.2	< 0.001**
Diabetes mellitus (DM)	9 (28.1%)	7 (17.9%)	17 (30.4%)	33 (26.0%)	0.379
DM + DS	2 (6.3%)	5 (12.8%)	7 (12.5%)	14 (11.0%)	0.758
Satisfaction grade[1]	1.0 ± 0.4	1.0 ± 0.9	1.0 ± 0.7	1.0 ± 0.7	< 0.001**
Undergo surgery again (yes)	31 (96.9%)	30 (76.9%)	53 (94.6%)	114 (89.8%)	0.032*

[a] Values are presented as mean ± one standard deviation

[1] 1=very good, 2=good, 3=satisfactory, 4=sufficient, 5=not sufficient

[b] *P < 0.05. **P < 0.01

Figures

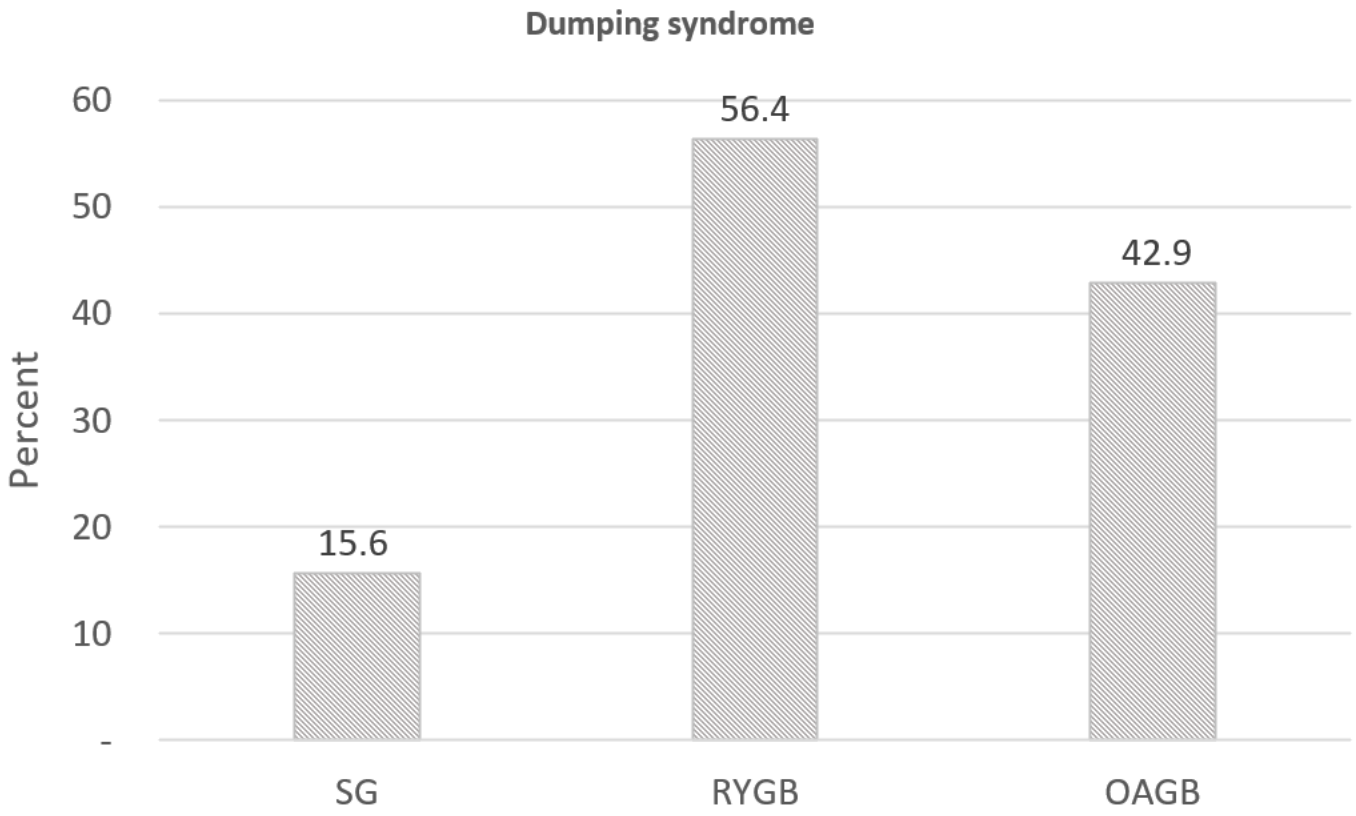

Figure 1

Incidence of dumping syndrome after SG, RYGB and OAGB