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ORIGINAL ARTICLE

Predicted weight loss result of laparoscopic sleeve gastrectomy: Review of the first 82 consecutive patients in an Asian bariatric unit

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Summary *Background:* Obesity is a great concern in developed countries such as Taiwan. Laparoscopic sleeve gastrectomy (LSG) is becoming a popular and stand-alone bariatric procedure. The aim of this study is to analyze the factors that affect the weight loss outcome in our patients after LSG.
Methods: Eighty-two consecutive patients who underwent LSG between Oct. 2012 and Sept. 2015 were included. Patients were asked to fill out questionnaires during first visit. The endpoint of this review was the factors affecting excess weight loss (%EWL) ≧ 50% at post-operative 12-months.
Results: Sixty-seven patients (81.7%) completed 12 months of post-operative follow-up. The pre-operative mean weight and height were 109.7 kg and 165.7 cm (BMI of 40.4 kg/m^2). There was no surgical mortality, but 2 (2.4%) patients suffered from severe complications. The mean post-operative body weights in post-operative months 1, 3, 6 and 12 were 100.4 kg, 90.5 kg, 88.0 kg, 83.6 kg, with 18.8%, 37.1%, 57.1% and 51.2% EWL. The percentage of total weight loss (%TWL) after 12 months follow-up was 23.2%. In univariate analysis, younger patients achieved better than 50% EWL ($p = 0.013$). Patients who reported pre-operative alcohol consumption, without psychiatric history and without osteoarthritis showed a better trend of achieving 50% EWL. In multi-variate analysis, younger patients ($p = 0.042$), with pre-operative alcohol consumption ($p = 0.036$) and without psychiatric history ($p = 0.040$) significantly achieved more than 50% EWL.

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Conclusion: Younger age, pre-operative alcohol consumption and absence of psychiatric disease were positive predictor factors for successful weight loss after LSG.

1. Introduction

Obesity has become a focus of great concern in developed countries. According to the World Health Organization (WHO), in 2014, more than 1.9 billion adults aged 18 years and older were overweight. Of these, over 600 million adults were estimated to be obese. Globally, obesity is responsible for the largest share of health care related expenditure.[1,2] In Taiwan, according to the Health Promotion Administration under the Ministry of Health and Welfare, the prevalence of overweight and obesity is 43%. Obesity usually appears with co-morbidities such as premature mortality, hypertension (HTN), cardiovascular disease, type II Diabetes Mellitus (DM), obstructive sleep apnea (OSA), degenerative joint disease like osteoarthritis (OA), dyslipidemia, and psychosocial consequences like depression, anxiety, etc.[2–4] In extreme cases (BMI$\geqq$ 40 kg/m^2), obesity causes more prominent co-morbidities and greater chances of earlier mortality.[5] Management of obesity is necessary, however, non-surgical treatment, such as exercise, diet and medication, usually fail to deliver satisfactory and durable weight loss in morbidly obese patients.[6] Compared with conservative treatment, surgical treatments are more effective in achieving and maintaining a significant weight loss.[7] Furthermore, surgical treatments decrease obesity-related co-morbidities and mortality, while increasing quality of life.[8]

According to the American Society for Metabolic and Bariatric Surgery (ASMBS) website (https://asmbs.org) online learning center, operation options include laparoscopic Roux-en-Y gastric bypass (RYGB), adjustable gastric banding, laparoscopic sleeve gastrectomy (LSG), biliopancreatic diversion with duodenal switch, etc. Laparoscopic RYGB used to be the gold standard for bariatric surgery. LSG was first introduced by Dr. Doug Hess in 1998, and recent studies have shown that LSG results in good weight loss results with a significant reduction or resolution of co-morbidities. LSG is now becoming increasingly popular as a stand-alone bariatric procedure.[9–11]

Predictor factors affecting the weight loss result have been reported for laparoscopic RYGB, and include being married, male gender, BMI over 50 kg/m^2, and DM.[12–15] However, few studies have analyzed the predictors of LSG, especially among Asian morbidly obese patients. The aim of this study is to analyze our morbidly obese patients who have undergone LSG and to identify the factors that affect the weight loss outcome.

2. Patients and methods

2.1. Participants

Patients who fit the recommendation for Asian bariatric surgery by the Asia–Pacific Bariatric Surgery Group consensus meeting in 2005 [16] were included for bariatric surgery. The indications include:

BMI $\geqq$ 37 kg/m^2
BMI $>$32 kg/m^2 with diabetes or two other obesity-related co-morbidities
Inability to lose weight or maintain weight loss by dietary or medical measures.
Age of patient $>$18 years and $<$65 years.

We recruited 82 consecutive patients who fit the recommendation and underwent LSG between Oct. 2012 and Sept. 2015, of whom 67 completed 12 months of post-operative follow-up and were included for analysis.

2.2. Questionnaires

Patients were asked to fill out questionnaires during their first outpatient clinic visit decribing the amount of food consumption, alcohol consumption, sweets (sugar containing food between meals) and soft drinks (sugar containing, but alcohol free drinks) etc. To evaluate the food intake amount before surgery, the amount of food consumed per meal was measured by inquiring whether a typical Taiwanese convenience-store lunch box was enough for a full meal (about 600–700 kcal). If patients had one lunch box for each meal, the meal amount was defined as normal. If patients needed more than one lunch box, the meal amount was defined as large. However, if patients had strictly control their diet and did not finish the lunch box, the meal amount was defined as small. Alcohol consumption was defined as $>$ 30 cc alcohol weekly (eg. 600 cc 5% beer, 75 cc 40% Whisky).

During outpatient clinic visits, body weight and height were also recorded. Ideal body weight was calculated and recorded using the following formula: (kg) (Male: (height (cm) - 80) x 0.7; Female: (height (cm) - 70) x 0.6)).

Co-morbidities including hypertension, diabetes mellitus (DM), fatty liver (diagnosed by elevated liver function and abdominal echo), psychiatric disease, osteomyelitis (OA), and gout were recorded. Psychiatric diseases including anxiety, bipolar disorders, depression, schizophrenia, etc. were diagnosed by psychiatrists, and all were confirmed to be well controlled with a statement from our psychiatrists' department. For patients without psychiatric disease, the psychiatrists' department was still consulted before surgery, and if any uncontrolled psychiatric disease was diagnosed, surgery was withheld. Non-operative weight loss attempts including medication (prescribed by endocrinologist or family medicine doctor), Chinese medicine (prescribed by certified Chinese medicine doctor), low calorie diet (commercial product recommended by nutritionist), exercise (30 min per day at least once a week) and diet

were recorded. The weight loss result of non-operative attempts was also recorded for analysis.

2.3. Pre-operation evaluation

In the outpatient department, the pre-operative laboratory data was checked, including hemogram and biochemistry (blood sugar, glycated hemoglobin, renal function, liver function, lipid profile, thyroid function and cortisol level). Pre-operative Esophago-gastroduodenoscopy (EGD) was performed and findings such as gastritis, gastric or duodenal ulcer, gastroesophageal reflux disease (GERD) were recorded as positive. Patients with GERD Los Angeles classification B or more or hiatal hernia were excluded for SG and RYGB was advised.

2.4. Operation procedure

All patients accepted laparoscopic sleeve gastrectomy. Patients were placed in supine position with the operator standing to the right hand side and the camera man to the left hand side of the patient.

Pneumoperitoneum was created through a mini-laparotomy under 12 mm-Hg pressure. Five trocar ports were placed including two 12 mm trocar ports in the supra-umbilical area and right subcostal area. An 11 mm trocar was placed in the left subcostal area for 10 mm 30-degree optical scope. A further two 5 mm trocars were placed, one in the left lateral abdomen for traction of the stomach and the other in the subxyphoid area for liver retraction. Dissection was started by detachment of greater omentum 6 cm from the pylorus up to the angle of His by Harmonic Scalpel® (Johnson & Johnson Medical KK, Ethicon Endo-Surgery, Cincinnati, OH). A Fr. 32 oral gastric tube was inserted through the lesser curvature up to the gastric antrum as a guide. Sleeve formation was performed by Endo GIA Universal Roticulator 60 mm (Covidien, AutoSuture). Hemostasis was performed and the staple line reinforced with 3-0 monocryl (Ethicon Inc) seromuscular suture. The fascia layers of the 12 mm and 11 mm trocar ports were closed and the wounds were closed without drainage. Operation date, duration, perioperative complications and hospital stay were recorded.

2.5. Post-operation follow-up

After operation, patients were discharged on post-operative day 3 if there were no perioperative complications. Patients were followed up in outpatient clinics at post-operation 1st week, 1st, 3rd, 6th and 12th months. The post-operative body weight, complications, and any medication changes for underlying diseases were carefully recorded. Endpoint of this review was post-operative BMI and percentage of excess weight loss (%EWL) at 12th months after surgery. %EWL was calculated as ((weight before surgery-body weight at 12 months after surgery)/(weight before surgery - ideal body weight))*100%. Post-operative EGD was not routinely performed unless patients showed clinical symptoms of gastrointestinal bleeding, gastroesophageal reflux disease (GERD) or stenosis etc.

2.6. Statistics

Each factor in a patient's questionnaire was compared against their %EWL result, either $\geqq$ 50% or $<$50 %EWL. Patients with $\geqq$ 50 %EWL in post-operative month 12 were defined as having achieved a successful outcome. Categorical data were analyzed with Chi-square test and Fisher's test if the expected count was less than 5. Logistic regression techniques were used to analyze the influence of other variables. All data were calculated with the IBM SPSS software Version 22.

3. Results

From October 2012 to September 2015, a total of 82 patients received LSG, 67 (81.7%) of whom finished the pre-operative questionnaires and completed 12 months follow-up, and were retrospectively reviewed. There were 27 males and 40 females. The mean age was 36.2 years old. Pre-operative mean weight and height were 109.7 kg and 165.7 cm, respectively, with a mean BMI of 40.4 kg/m^2.

The mean post-operative body weights in post-operative months 1, 3, 6 and 12 were 100.4 kg, 90.5 kg, 88.0 kg, and 83.6 kg, respectively. The mean BMI at post-operative month 12 was 30.4 kg/m^2. 35 patients (52.2%) had %EWL

Table 1 Patients' baseline data and result of questionnaires.

		Number of patients (% of total patients)
Age (y/o)	$\leq$50	56 (83.6%)
	$>$50	11 (16.4%)
Gender	Male	27 (40.3%)
	Female	40 (59.7%)
Body mass index (BMI) (kg/m$_2$)	$<$35	10 (14.9%)
	$\geq$35, $<$50	53 (79.1%)
	$\geq$50	4 (6.0%)
Eating Habits		
Eating amount	large	28 (41.8%)
	normal	33 (49.3%)
	small	6 (8.9%)
Soft drinks		39 (58.2%)
Alcohol consumption		22 (32.8%)
Sweet food		38 (56.7%)
Weight loss attempts		
Medication		46 (68.7%)
Chinese medications		36 (53.7%)
Low calorie diet		35 (52.2%)
Exercise		42 (62.7%)
Diet control		54 (80.6%)
Weight loss attempts $>$2 methods		47 (70.1%)
Co-morbidities		
Diabetes Mellitus		11 (16.4%)
Hypertension		32 (47.8%)
Psychiatric history		11 (16.4%)
Osteoarthritis (OA)		34 (50.7%)
Positive Esophagogastro-duodenoscopy (EGD) finding		52 (77.6%)

≧ 50%. The mean %EWL's in post-operative months 1, 3, 6 and 12 were 18.7%, 37.1%, 57.0% and 51.2%. The average total weight loss (TWL) was 26.0 kg and the percentage of TWL was 23.2% after 12 months follow-up.

Patients' eating habits, including amount of food, soft drinks, alcohol, and sweets are shown in Table 1. Regarding non-operative weight loss attempts, 13 patients had tried 5 methods, 16 patients had tried 4 methods, 18 patients 3 methods, 13 patients 2 methods, and 7 patients had tried 1 method. There was no surgical mortality and 2 (2.4%) patients suffered from Clavien-Dindo classification Grade III or IV complications needing further intervention. One patient, a 41 year old female, suffered from gastric tube leakage. She initially presented with fever, chills, and epigastric tenderness with peritoneal signs. She received re-operation and stent placement. The stent was removed after 6 weeks and the leakage healed. After 12 months, her %EWL was 26.55% and %TWL was 11.9%. Another patient, who encountered gastric tube stenosis, was re-admitted for hydration and a series of endoscopic dilatations in the outpatient department. For this patient, %EWL was 53.24% and %TWL was 25%. Newly diagnosed GERD after LSG was diagnosed by EGD in 11 patients (16.4%).

In univariate analysis, younger patients (≦ 50 years old) significantly achieved 50% EWL, compared to those over 50 years old (94.3% with 5.7%, Odds ratio 0.155 $p = 0.013$). Patients who reported pre-operative alcohol consumption showed a trend towards weight loss more than 50% EWL, but this did not achieve significance (42.9% with 57.1%, odds ratio 2.679 $p = 0.068$). 11 Patients were found with psychiatric disease history. Among them, 4 had bipolar disorder, 2 had depression, and 5 patients had anxiety. Patients without psychiatric history (odds ratio 0.4 $p = 0.070$) and without OA (odds ratio 0.4 $p = 0.070$ and $p = 0.066$) showed a trend towards weight loss greater than 50% EWL (Table 2), but this result did not achieve significance.

Table 2 Univariate analysis of predictors for weight loss outcome.

Factors- univariates		Excess weight loss (%)		Odds ratio (95% CI)	*p* value*
		EWL < 50%	EWL ≥ 50%		
67 patients completed 12 months after operation		32 (47.8%)	35 (52.2%)		
Age	≤50	23	33	0.155	0.013
	>50	9	2	(0.031–0.784)	
Gender	female	19	21	0.974	0.958
	male	13	14	(0.367–2.589)	
Eating amount	large	10	18		0.233
	normal	19	14		
	small	3	3		
Soft drink	No	14	14	1.167	0.808
	Yes	18	21	(0.441–3.084)	
Alcohol consumption	No	25	20	2.679	0.068
	Yes	7	15	(0.916–7.830)	
Sweet food	no	11	18	0.495	0.159
	yes	21	17	(0.185–1.326)	
Medications	no	9	12	0.75	0.587
	yes	23	23	(0.265–2.121)	
Chinese Medications	no	12	19	0.515	0.169
	yes	20	16	(0.190–1.342)	
Low calorie diet	no	15	17	0.934	0.890
	yes	17	18	(0.358–2.440)	
Exercise	no	14	11	1.697	0.298
	yes	18	24	(0.625–4.606)	
Diet control	no	8	5	2.000	0.268
	yes	24	30	(0.579–6.908)	
Weight loss attempts	≤2	9	11	0.854	0.768
	>2	23	24	(0.299–2.440)	
Psychiatric history	no	24	32	0.281	0.070
	yes	8	3	(0.067–1.174)	
Diabetes Mellitus	no	27	29	1.117	0.867
	yes	5	6	(0.305–4.089)	
Hypertension	no	15	20	0.662	0.401
	yes	17	15	(0.252–1.736)	
Osteoarthritis	no	12	21	0.400	0.066
	yes	20	14	(0.149–1.071)	
EGD findings	negative	5	9	0.535	0.310
	positive	27	26	(0.158–1.810)	

*$p < 0.05$ is defined as significance.

Table 3 Multi-variates analysis of predictors for weight loss outcome.

Multi-variates analysis	*p* value*	Odds ratio	95% CI
Age (<50, ≥50 y/o)	0.042	8.328	1.085—63.942
Alcohol (yes/no)	0.036	4.434	1.103—17.819
Eating amount (small)	0.272		
Eating amount (normal)	0.398	2.804	0.257—30.599
Eating amount (large)	0.982	1.027	0.098—10.729
Sweet food (no/yes)	0.472	1.647	0.423—6.417
Chinese medication (yes/no)	0.705	0.773	0.204—2.927
Exercise (yes/no)	0.199	0.349	0.070—1.739
Diet control (yes/no)	0.208	3.030	0.539—17.038
Psychiatric history (no/yes)	0.040	6.038	1.086—33.579
Osteoarthritis (no/yes)	0.341	1.914	0.503—7.280

*$p < 0.05$ is defined as significance.

In multi-variate analysis, patients aged ≦ 50 years old ($p = 0.042$), with pre-operative alcohol consumption ($p = 0.036$) significantly achieved weight loss more than 50% EWL (Table 3). Patients without psychiatric disorders had significantly better rate of successful weight loss (91.4% with 8.6% odds ratio = 6.038, $p = 0.040$) compared to those with psychiatric disease (Table 3).

4. Discussion

Laparoscopic sleeve gastrectomy has gained in popularity and is currently the most frequently performed procedure in the Asia/Pacific regions.[17] It can not only restrict the amount of intake, but also reduce the appetite[18] Compared to RYGB, LSG is relatively simple with fewer long-term post-operative complications. LSG weight loss result is similar to RYGB in prospective radomized trial with 82.97% post-operative 12 months %EWL.[19–22] In this study, we analyze our LSG patients and identify pre-operative the factors that affect the weight loss outcome.

In this study, better %EWL was observed in patients ≦ 50 years old. This result is consistent with a previous study by Contreras et al after LSG and RYGB. Older patients have decreased total energy expenditure (TEE) and frequently suffer from more co-morbidities, which might have an influence on their baseline physical conditions.[23] Roberts et al also reported that aging was associated with progressive declines in resting and TEE, both in normal and in overweight people. TEE fell by around 150 kcal per decade between 20 and 100 years of age in normal BMI people and overweight people.[24]

Pre-operative alcohol consumption was found to be a significant positive predictor for post-operative weight loss in our study. Dixon et al retrospectively reviewed their surgical result of 770 laparoscopic gastric banding patients. They demonstrated regular alcohol consumption was positively associated with better post-operative %EWL.[25] Alcohol is a silent calorie source, and 1 g of alcohol provides 7 kcal energy which is more than carbohydrate and protein (4 k cal per gram). Alcohol consumption is associated with excess calorie intake and results in weight gain.[26] Quitting alcohol consumption was strictly recommended to our patients before and after bariatric procedures to achieve better weight loss outcome. Our study is the first report that emphasizes the association between post-operative weight loss result of LSG and pre-operative alcohol consumption.

Obesity is frequently associated with depression, anxiety, or eating disorders.[27] Severe or uncontrolled psychiatric disease is a contraindication for bariatric surgery. Furthermore, psychiatric status might also be affected by obesity. Increased severity of obesity is associated with an increased risk of depression.[28] The prevalence of mood and anxiety disorders is also increased in obese patients, especially in women.[29,30] In our study, 11 patients (16.4% of the total) had psychiatric history and completed 12 months of follow-up. Patients without psychiatric disorders had significantly better rate of successful weight loss (91.4% with 8.6% Odds ratio = 6.038, $p = 0.040$) compared to those with psychiatric disease. Similar results were also reported by Semanscin-Doerr et al in their 104 LSG cases, whereby mood disorders were associated with significantly less weight loss after LSG.[31] A similar result was reported in RYGB by Kalarchian et al. 68.1% patients with an Axis I disorder, especially mood or anxiety disorders, exhibited poorer %EWL loss in 6 months than patients who had never had an Axis I disorder (47.7% v.s 56.9%).[32]

Anti-psychotic medications were correlated with weight gain, particularly clozapine and olanzapine, tricyclic antidepressants such as amitriptyline, and doxepin.[33,34] Anti-psychotic medications could induce changes in appetite and food intake due to interaction with serotonergic, histaminergic, and dopaminergic neurotransmitter systems.[35,36] A meta-analysis conducted by Maarten Bak et al concluded that almost all anti-psychotic mediations resulted in weight gain.[34]

There are several limitations to this current study. First, the result was based on a single institution and retrospective study. There were only a small number of patients and post-operative follow ups were limited to 12 months. Longer term follow ups are recommended for future studies. Some of the parameters were based on questionnaires which were completed at the clinic by the patients, potentially introducing some recall bias. These limitations notwithstanding, this is the first research to look into predictors of weight loss outcome after LSG based on an Asian population.

In conclusion, younger age, pre-operative alcohol consumption and absence of psychiatric diseases were positive predictor factors for %EWL after LSG.

Conflict of interest statement

The authors declare that they have no conflicts of interest.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.asjsur.2018.06.003.

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