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Evaluation of laparoscopic sleeve gastrectomy compared with laparoscopic Roux-en-Y gastric bypass for people with morbid obesity: A systematic review and meta-analysis

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Abstract

Background: Prevalence of obesity in the world, in both developed and developing countries, is growing rapidly. Bariatric surgery is now accepted as the treatment for morbid obesity.

Objective: This study compares laparoscopic sleeve gastrectomy's effectiveness (LSG) with the most common bariatric surgery, laparoscopic Roux-en-Y (LRYGB) gastric bypass.

Methods: A systematic review was performed using relevant search data bases, including Cochrane library, PubMed, Magi ran, Iranmedex, SID and Trip database, with no time limit. Data bases were searched until July 2014 for randomized control trials. The studied population included people aged between 18–60 years, with BMI≥35 and at least one obesity-related disease, or people with BMI≥40. BMI change, as the research outcome, was investigated at least in one-year follow-up period. Cochrane criteria were used to assess quality of studies. The results were extracted from the articles.

Results: In total, 384 articles were obtained in the search; six RCTs were included in this study. There was no significant difference between the two laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass procedures in BMI, and both groups were similar in weight loss CI [-.1.31, 0.43], p=0.32.

Conclusion: The two procedures of bariatric surgery are effective and reliable treatments. Performing more trial studies with greater sample size and longer follow-up period for making final decision in selecting a certain surgical procedure is essential.

Keywords: Sleeve gastrectomy, Roux-en-Y gastric bypass, Morbid obesity.

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Introduction

The prevalence of obesity in the world, for both developed and developing countries is growing rapidly (1). The body mass index of 4.7% and 1.3% of excessively obese persons in the US and Iran, respectively, is greater than 40. The rate of obesity in the United States is relatively similar for women and men (33.3% versus 35.3%). In Iran, women account for the greater number of obese people (30% in female versus 17% in men) (2-4). It is predicted that obesity rate in the US will increase to almost 3-4% in 2020 (5). In Iran, this rate will rise from 42.8% to 54% and from 57% to 74% within 2005-2015 in women and

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men, respectively (6). Several diseases such as type II diabetes, hypertension, osteoarthritis, sleep apnea, nonalcoholic fatty liver, and rectum, colon, esophagus, and pancreas cancers are related to obesity (1,7). Some of them like cardiac diseases, stroke, and some cancers may be the main cause of death (8). Obesity and overweight, induced by the lack of exercise and poor diet, account for 300,000 deaths per year (9-11). Except from bariatric surgery, the common practices for weight control are not effective in long-term (12-15). Diet, exercise, behavioral modification, and medication have a limited and weak impact on weight loss. A low-calorie diet can reduce body weight by an average of 8% over 6 months (Very low- calorie diet). It also gets down body weight by 15-25% after 3-6 months, but has a weak result in long-term (9% and 5% weight loss after one and four years, respectively) (16). Physical activity alone causes slight weight loss of 2-3% at its best (16).

Bariatric Surgery

Bariatric surgery provides for people with obesity-related diseases not only sustainable weight loss but also more benefits and this significant weight loss decreases the relative risk of mortality (15,17-19). The common guidelines recommend bariatric surgery for people with BMI>40 or people with greater than 35, who also have obesity-related diseases (20). The selected surgery procedure should be associated with a lower risk (mortality and disease rates of lower than 1% and10%, respectively); it also should reduce body weight by 50%, sustain it at least for five years, and benefit more than 75% of the patients (21).

Bariatric surgical procedures can be classified as primarily malabsorptive or primarily restrictive. The latter are defined based on mechanical restriction or limitation of the size of the stomach, and include surgical procedures. LSG involves formation of a gastric “tube "to restrict the size of stomach; however, this procedure is irreversible. In contrast, primarily malabsorptive bariatric surgical procedures such as Roux-en-Ygastric bypass (RYGB) involve resection of the stomach to form a small gastric pouch along with rearrangement of the small bowel to bypass the duodenum and deliver gastrointestinal contents directly to the distal jejunum. The bypass is achieved by attaching a Roux limb to the gastric pouch (8).

Two widely used bariatric surgery procedures are laparoscopic Roux- en- Y gastric bypass (LRYGB), and laparoscopic sleeve gastrectomy (LSG). Sleeve gastrectomy is relatively a new bariatric surgery, which is safe and effective procedure, for patients with excessive obesity (22). This study evaluates effectiveness of two surgery procedures (defined as BMI change). We conducted a systematic review and meta-analysis and random effect models were used to analyze the data.

Study Objective

In this study, the effectiveness of laparoscopic sleeve gastrectomy is compared to that of the other procedure, to produce evidence to help general surgeons that decide in selecting the best procedure.

Methods

To evaluate the effectiveness of laparoscopic sleeve gastrectomy in comparison with LRYGB, a systematic review was done. Search in a number of appropriate databases such as Magiran, Iranmedex, SID, Cochrane Library, PubMed, Trip database and Google scholar was performed using keywords including bariatric surgery, laparoscopic sleeve gastrectomy, laparoscopic Roux-en-Y gastric bypass (LRYGB). The query was free of temporal and linguistic limitations. To improve the comprehensiveness of the search and to complete the information, Ovid Medline was searched. All founded articles were entered in EndNote, duplicate papers were removed, topics and abstracts of the articles were reviewed, and irrelevant studies were excluded. After matching the remaining articles with inclusion and exclusion crite-

ria, relevant papers were entered in the final assessment stage and analyzed. The investigated population included people aged between 18–60 years, with BMI≥35 and at least one obesity-related disease, or people with BMI≥40. For this study, BMI change, as research outcome, was investigated at least in one-year follow-up period. Surgical intervention was LSG that compared to LRYGB procedure. This was a randomized clinical trial. Cochrane criteria were used to assess quality of studies. The quality of articles was evaluated by two reviewers independently. In case of disagreement regarding a specific study between 2 authors, we recruited a third individual to participate in the decision making.

Data extraction

Two authors independently performed the data retrieval for both LSG procedure and comparison group. The 2 sets of data were compared; in case of disagreement, the results were rechecked. The data extracted included the year of publication, country, sample size, types of interventions, and duration of follow up, preoperative BMI, and postoperative BMI.

Statistical analysis

Statistical analysis was done using a review manager software (Revman). We calculated a pooled variance mean for the statistical synthesis of the change in BMI at the time of follow-up by considering, the standard deviation and the sample size of the raw data if possible. Statistical heterogeneity was tested by the I^2 test. We used random effect model. The pooled mean difference with a 95% confidence interval was used to assess outcome. The significance was determined by the Z-test. Statistical significance was considered at $p<0.05$. These data on bariatric surgery were extracted and summarized for both groups from each included trial. If BMI was not reported in standard format, the corresponding author of the manuscript was contacted. In the event of no response, we conducted a qualitative (descriptive) analysis

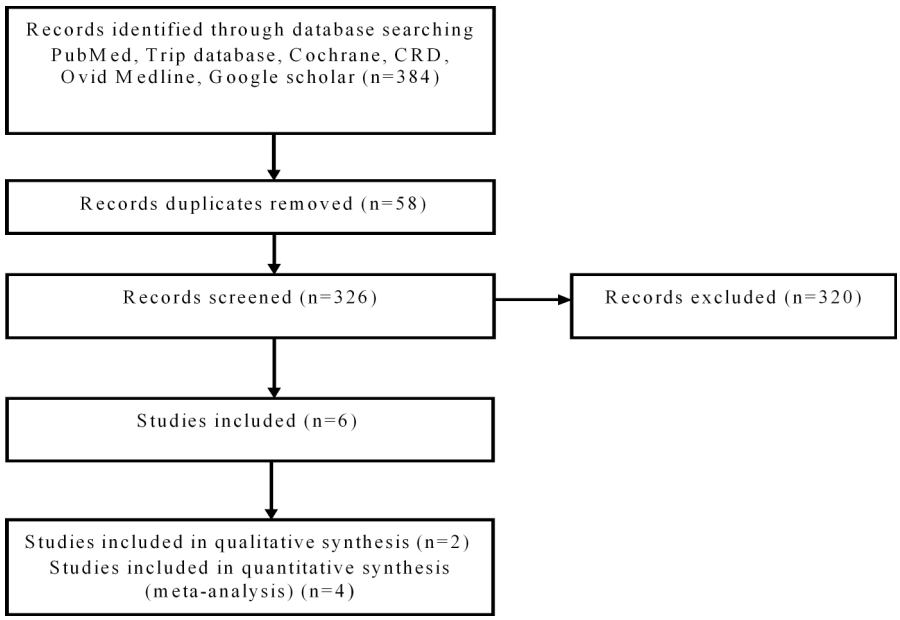

Diagram. 1. A flowchart describing the process of identifying relevant literature

by assessing the number of RCTs that had a comparison between the LSG and the LRYGB procedures.

Results

In initial search based on research keywords, search strategy, and inclusion and exclusion criteria, 384 articles were obtained. After deleting duplicate and irrelevant articles, six randomized control trials were eventually included for final evaluation and were evaluated for quality (Diagram 1) (23-28). Cochrane criteria were applied to the included randomized control trials. Only four out of six randomized control trials, in which weight change outcome was mentioned, were meta-analyzed, as they were appropriately homogeneous.

Quality Appraisal Results

The reviewed studies, using the Cochrane quality evaluation criteria, were entered into Rev Man software. Images showed high quality of Ioannis Kehagias and Karamanakos's studies, medium quality of Ralph Peterli, Michel Vix, Jose Manuel Ramón studies, and low quality of Bettina Woelnerhanssen study (Fig. 1).

Methodological and risk of bias assessments

The results of risk bias assessment are shown in Fig. 2. Six studies clearly reported the process of randomization used. The process of allocation concealment was described in only 2 studies (including IoannisKehagias and Karamanakos studies).

Fig. 1. Assessment of risk of bias for the included studies.
Low, high, and uncertain biases are represented by positive mark, negative mark, and no mark, respectively.

Use of a sealed, opaque, and sequentially numbered envelope was not mentioned in other studies. Only 2 studies reported blinding. Patients and the outcome assessors were blinded in two studies (IoannisKehagias and Karamanakos).

Considering the fact that some studies reported BMI and some reported the percentage of excess weight loss (EWL %), and some information provided by some articles were incomplete (lack of report on EWL% and standard deviation), BMI was selected as the effectiveness criterion for

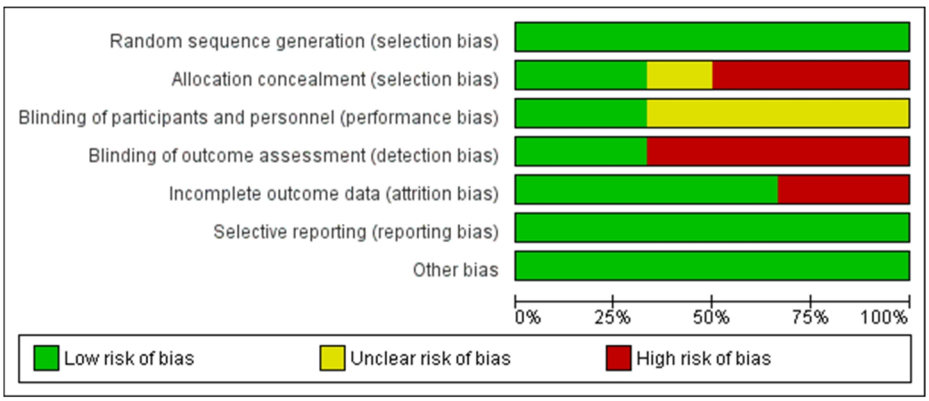

Fig. 2. Risk of bias using the Cochrane criteria

Table 1. The outcome of BMI before and after the operation

References	Procedure	Preoperative BMI	Postoperative BMI
Ioannis Kehagias 2011	LSG	3.4±44.9	4.1±29.6
	LRYGB	3.7±45.8	3.9±31.3
Karamanakos 2009	LSG	3.6±45.1	3.6±29
	LRYGB	3.7±46.6	3.4±31.5
Bettina Woelnerhanssen 2011	LSG	1.6±44.7	1.4±32
	LRYGB	2±47.6	2.2±31.1
Ralph Peterli 2012	LSG	5.3±44.7	5±32
	LRYGB	6.8±47.6	7.5±31.1

performing meta-analysis. A total number of 138 subjects were entered in the meta-analysis. As the pre- and post- operation BMI difference was considered (Table 1), the mean and standard deviation of this change were calculated according to the mean and standard deviation provided in the studies. The obtained information was then entered into RevMan software.

Analysis of BMI

According to Forest plot diagram, there was no significant difference between the two groups in BMI, and both groups were similar in weight loss CI [-1.31, 0.43], p=0.32, and heterogeneity of studies was I^2=82% (Fig. 1 in Appendix).

To investigate the cause of this high level of heterogeneity, a meta-analysis was done once again by excluding the Bettina's study, due to its low quality. The meta-analysis result (I^2=33%) indicated the homogeneity of the remaining studies. The difference in BMI between the two surgical procedures was not significant and both procedures showed the same weight loss effects. The Forest plot diagram shows CI [-0.42, 0.51] p=0.86 (Fig. 2 in Appendix).

In a 1-year follow-up survey by Mitchel Vix et al, the primary outcome of the trial was considered to be the capability in obtaining EWL% in LRYGB and LSG groups. After dividing 100 subjects into LRYGB and LSG groups, randomly, EWL rates (in percent) were obtained as 80.38% and 82.97% for LRYGB and LSG, respectively, 12 months after the follow-up. In addition, the follow-up rates were 97.74% and 87.3% for LRYGB and LSG, respectively. Jose Manuel Ramonet al. performed a comparative trial study about the relationship between LRYGB and LSG on 15 patients. The result was in favor of LRYGB. The two groups had similar pre-operation BMI (44.2±2 in LRYGB and 43.5±3 in LSG). The mean BMI at 12-month follow-up was significantly lower in LRYGB group than LSG group (p=0.016).

Discussion

In terms of the effectiveness of LRYGB and LSG procedure in weight loss, meta-analysis indicated a similarity between them. In a systematic review on weight loss, Stefano Trastulli reported that in the LSG group, EWL% ranged from 49% to 81% (in a 1.5-year follow-up); and in the LGB group EWL% ranges were 62.1-94.4% (1.5 years follow-up, on average). There was no statistical difference in EWL% or the percentage of excess body mass index loss (EBMIL %) between LSG group and other procedure (29). Lim et al performed study on patients and were followed for five years and reported the same weight loss in LRYGB and LSG groups in long-term (30), which was consistent with our findings. In addition, Su-Hsin Chang (2014) reported that LRYGB and LSG were comparable in terms of weight loss (12). There are also some studies contradicting our findings on the effectiveness of weight loss. Li et al (2013) performed a meta-analysis on 16 studies containing 2,758 patients. This study demonstrated that RYGB has a better effect on weight loss compared to LSG at 12 months (31). In contrast, some studies reported higher weight loss after LSG (32). In a meta-analysis on randomized and non-randomized controlled trials, Jian Fang Li proved that weight loss after RYGB is

more than SG, but not statistically significant (1). Carlin et al. (2013) in a cohort study used clinical information in a statewide clinical registry to match 2,949 SG patients with equal numbers of RYGB patients on 23 baseline characteristics. Excess body weight loss at 1 year was 13% lower for SG (60%) than for RYGB (69%, p< 0.0001)(33). A review by Fischer et al. analyzed 123 studies for a total of 12,129 patients undergoing LSG and noted a 59% mean of %EWL at the 1-year follow-up (54 papers), 64.5% at 2 years (11 papers), 66% at 3 years (6 papers), and 60.9% at 4 years (only 3 papers) (34).There were some limitations in this meta-analysis including limited number of studies and number of patients in each study; this may have biased the results.

Conclusion

In general, our study showed a similarity between LSG and LRYGB in weight loss. However, it seems that the small number and size of trials are the causes of similarity and dissimilarity between the effectiveness of LSG and LRYGB in reduction of BMI. Performing more trials with greater sample size and longer follow-up period is essential for making a better final decision and selecting a certain surgical procedure. The effectiveness of LGS in achieving a stable weight loss in a long-term follow-up is still not clear, due to the lack of data. Up to now, the majority of studies are observational, non-randomized, and randomized control trials with follow-up period of less than five years for the LSG patients.

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Appendix

Table 1. Articles included

No	Quality study	Comparison	Intervention	Sample size	follow-up	Country	Study design	Author, Publisher
1	High	LRYGB	LSG	60	3	Greece	RCT	IoannisKehagias 2011
2	High	LRYGB	LSG	32	1	Greece	RCT	Karamanakos 2009
3	Low	LRYGB	LSG	23	1	Switzerland	RCT	Bettina Woelner-hanssen 2011
4	Medium	LRYGB	LSG	100	1	France	RCT	Michel Vix 2012
5	Medium	LRYGB	LSG	23	1	Switzerland	RCT	Ralph Peterli 2012
6	Medium	LRYGB	LSG	15	1	Spain	RCT	JoséManuel Ramón 2011

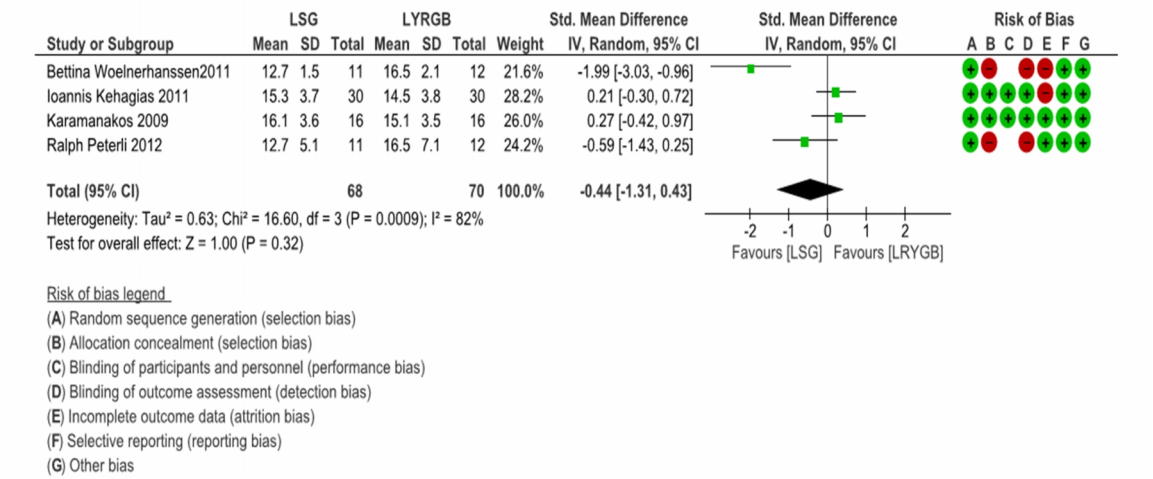

Fig. 1. A meta-analysis the outcome of BMI in 4 studies,CI indicates confidence interval, laparoscopic Roux- en- Y gastric bypass (LRYGB), laparoscopic sleeve gastrectomy (LSG).

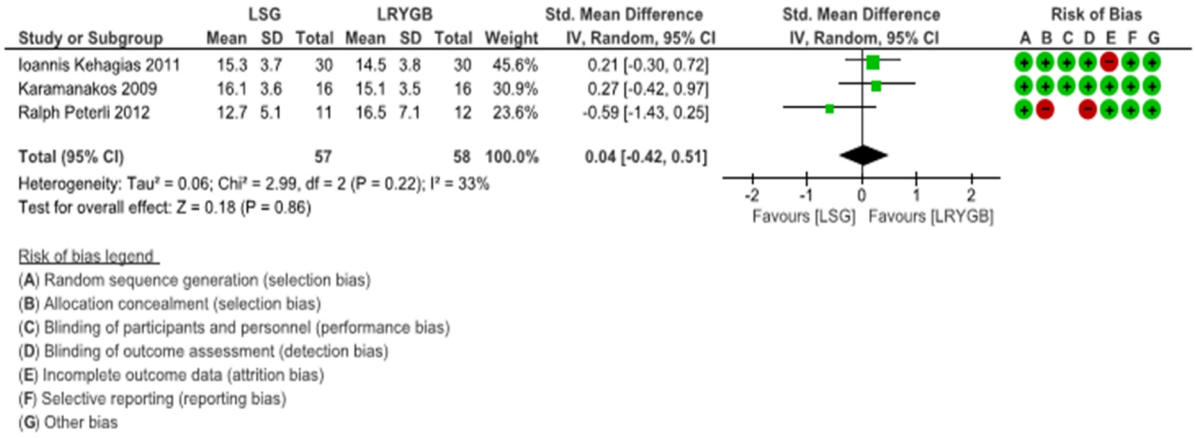

Fig. 2. A meta-analysis the outcome of BMI (excluding the Betina's study), CI indicates confidence interval, laparoscopic Roux-en-Y gastric bypass (LRYGB), laparoscopic sleeve gastrectomy (LSG).