



Review

The effectiveness and safety of laparoscopic sleeve gastrectomy with different sizes of bougie calibration: A systematic review and meta-analysis

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ABSTRACT

Objectives: This systematic review and meta-analysis was performed to compare the influence of different calibrating bougie sizes on clinical outcomes in laparoscopic sleeve gastrectomy (LSG) for patients with obesity. **Materials and methods:** A systematic review of the literature was performed using the key words: “laparoscopic sleeve gastrectomy”, “bougie size”, “calibration”, “obesity”, and “obese” for searches of electronic databases up to October 2017. Clinical characteristics such as, the percentage of excess weight loss (%EWL), overall complications, gastrointestinal leaks, gastroesophageal reflux disease (GERD) were pooled by meta-analysis. Stata 12.0 (Stata Corp, College Station, TX, USA) was used to perform the meta-analysis.

Results: Data were extracted from 11 original studies matching our inclusion criteria. In our review, the group of patients who had operations with thinner bougies had a greater %EWL (SMD 0.23, 95% CI 0.14–0.33, $P < .001$) than the group where larger diameters were used. Furthermore, no significant differences were found in the incidence of overall complications (OR 1.00, 95% CI 0.73–1.37, $P = .978$), postoperative gastrointestinal leaks (OR 0.91, 95% CI 0.67–1.24, $P = .554$), and GERD (OR 0.77, 95% CI 0.37–1.59, $P = .476$) between the two groups. A robust result could not be made about remission of comorbidities using differing diameter bougies due to insufficient data.

Conclusions: Use of thinner diameter bougies in LSG was more effective in enabling weight loss and did not increase the risk of overall complications, gastrointestinal leaks or GERD compared with larger diameter bougies.

1. Introduction

The global obese population continues to increase [1]. Bariatric surgery has been proven to be the most effective modality for comorbidity reduction in the morbidly obesity [2]. Current surgical treatments can be into three categories: restrictive procedures, malabsorptive procedures or both [3,4]. Laparoscopic sleeve gastrectomy (LSG) has gained popularity as a standalone procedure in recent years for its multiple advantages: low complexity surgical procedure, and very low risk of internal hernia, dumping syndrome, or marginal ulcer of stomach [5,6]. This procedure involves a longitudinal transection of most of the stomach fundus, body and antrum directed by a bougie, creating a gastric tube along the lesser curvature [2]. However, there are still technical controversies within the surgical field, particularly about if calibrating bougie size during surgery determines the residual capacity of the stomach and whether bougie size is an impact on the

effectiveness and safety of LSG [7]. Recently, the majority of the international sleeve gastrectomy expert panel concluded that the thinner bougies result in more weight loss due to improved volume restriction and the optimal bougie size is between 32 and 36 Fr. However, some experts have stated that thinner diameters are related to a higher risk of postoperative gastrointestinal leaks and gastroesophageal reflux disease (GERD) resulting from increasing intra-luminal pressure [5]. This systematic review and meta-analysis was undertaken in an attempt to compare the influence of different bougie sizes on clinical outcomes of patients with obesity who have undergone LSG.

2. Materials and methods

2.1. Search strategy

We searched the electronic databases PubMed, Embase, and the

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Cochrane Library for literature published prior to October 2017 using the following keywords: “sleeve gastrectomy”, “bougie size”, “obesity”, and “technique”. The reference lists of each identified publication were examined by a reviewer for additional relevant studies.

2.2. Selection of articles

Studies focusing on the effectiveness and safety of LSG in patients with obesity with different sizes of bougie calibration were included. In our review, we divided enrolled patients into two groups depending on bougie size used in their LSG procedure: a thinner bougie diameter group and a larger bougie diameter group. We defined thinner diameters as equal to or less than 36 Fr and larger diameter as more than 36 Fr. Our meta-analysis contained at least one of these outcomes: the percentage of excess weight loss (%EWL), incidence of postoperative overall complications, gastrointestinal leaks, GERD and comorbidity remission. Surgery failure was defined as a post-operative %EWL less than 50% [8]. Comorbidity remission criteria for our review was reduction or withdrawal of relevant medications [9].

Studies were excluded from our analysis for the following reasons: unavailable data, duplicate articles, testing of overlapping population, only abstract available, non-clinical publications (animal experiments, reviews, case reports and letters).

2.3. Data extraction

For all included studies, two reviewers independently extracted the following information and variables from each original study: the name of the first author, publication year and origin country, number of subjects, mean age, bougie size, staple line reinforcement used, follow-up time, patient BMI, %EWL, overall complications, gastrointestinal leaks, GERD, any other obesity-related co-morbidities. If there were opposing views between the two reviewers, a third person would make the decision. Moreover, reviewers could contact the included article authors to obtain more information if important data were absent.

2.4. Statistical analysis and quality assessment

The systematic review and meta-analysis was carried out based on the guidelines of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement [10]. Stata 12.0 (Stata Corp, College Station, TX, USA) was used to carry out the meta-analysis. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated on pooled effects for dichotomous variables (overall complications, gastrointestinal leaks, GERD) with a random-effect model, while the standard mean difference (SMD) with 95% confidence intervals (CIs) were calculated for continuous variables (%EWL). I^2 was used to evaluate statistical heterogeneity with a value < 30% representing low heterogeneity, a value between 30 and 50% representing intermediate heterogeneity and > 50% representing high heterogeneity. Sensitivity, subgroup and meta-regression analyses were performed to investigate potential sources of heterogeneity if necessary and possible. Begg's and Egger's tests were used to assess publication bias. $P < .05$ was regarded as statistically significant.

Revised Jadad rating scale was selected to assess the quality of randomized control trials (RCTs), while, Newcastle-Ottawa scale was appropriate for assessment of cohort and case-control studies. Discrepancies were discussed and consensus was reached with an arbitrator.

3. Results

Overall, 1104 studies were identified in our initial search, of which 31 underwent full-text review (Fig. 1). Finally, 11 studies [11–21] involving 6068 patients fulfilled the all inclusion criteria as described, and were included in our meta-analysis (Fig. 1). Detailed information

for the other 20 excluded studies is accessible in [Supplementary Material S1](#). The baseline demographics of included studies are shown in [Table 1](#), and relevant clinical outcomes are shown in [Table 2](#). The median length of follow-up was 12 (12–60) months. Results of the quality assessment of all included studies were satisfying and are shown in [Supplementary Material S2](#).

3.1. Weight loss

A total of four studies [11,14,16,18] (Fig. 2) reported %EWL in patients who had undergone LSG within the two patient groups. A random effect model demonstrated that the thinner diameters group had a better effective weight loss than the large diameter group (SMD 0.23, 95% CI 0.14–0.33; $P < .001$). No heterogeneity was recorded in these studies ($I^2 = 0$, $P = .647$). Neither the Begg's ($P = .308$) test nor the Egger's ($P = .154$) test showed publication bias. Sensitivity analysis did not indicate a significant result (data not shown). No subgroup analysis was performed because inter-study heterogeneity was not significant.

3.2. Overall complications

Eight studies [11–16,19,21] (Fig. 3) discussed the overall complications after LSG. No significantly statistical difference between two groups was recorded (OR 1.00, 95% CI 0.73–1.37, $P = .978$), the heterogeneity was low among these studies ($I^2 = 27.4\%$, $P = .210$). No bias of publication was found with Begg's ($P = .902$) and Egger's ($P = .249$) tests, a sensitivity analysis did not present a significant result (data not shown). Subgroup analysis was not performed because inter-study heterogeneity was not significant.

3.3. Gastrointestinal leaks

Seven studies reported postoperative gastrointestinal leaks [11,13–16,19,20] (Fig. 4). There was no significant difference in leaks between the two study groups (OR 0.91, 95% CI 0.67–1.24, $P = .0554$), and there was no heterogeneity in these studies ($I^2 = 0$, $P = .660$). There was no bias of publication noted with Begg's ($P = .368$) and Egger's ($P = .698$) tests. None of the studies were found to influence the results significantly in a sensitivity analysis (data not shown). Subgroup analysis was not performed because inter-study heterogeneity was not significant.

3.4. GERD

Three included studies reported the incidence of GERD among patients [11,17,21] (Fig. 5). A random effect model showed that there was no significant difference in the incidence of GERD (OR 0.77, 95% CI 0.37–1.59, $P = .476$) between the two groups. The heterogeneity of these studies was low ($I^2 = 24.3\%$, $P = .267$). There was no publication bias found with Begg's ($P = 1.000$) and Egger's ($P = .688$) tests. These studies were not found to influence the results significantly in a sensitivity analysis (data not shown). Subgroup analysis was not performed because heterogeneity was not significant.

4. Discussion

To our knowledge, this is first systematic review and meta-analysis comparing the effectiveness and safety of LSG using different bougie sizes. In our review, thinner diameter bougies are not an adverse factor for postoperative complications, gastrointestinal leaks and GERD in comparison to the larger diameter bougies. Furthermore, patients with obesity who received LSG with thinner diameter bougies had more weight loss than those who had received LSG with the larger bougies.

A correlation between more excess weight loss and the application of thinner bougies has been well characterized [22,23]; this correlation

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