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ORIGINAL ARTICLE

Evaluation of Food Tolerance after Laparoscopic Sleeve Gastrectomy in Relation to the Distance of Resection from the Pyloric Ring

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Abstract

Background: ***Obesity, a major health crisis, is significantly associated with increased mortality and various serious health conditions, leading to the rise of surgical interventions.***

Aim of the work: ***To evaluate the effects of the distance of resection from the pyloric ring on changes in body mass index (BMI), estimated weight loss (%EWL), and food tolerance following laparoscopic sleeve gastrectomy (LSG).***

Methods: ***This prospective, randomized trial involved 50 morbidly obese patients. Two approaches were compared: a total antral sacrifice starting 2 cm from the pylorus (Group A) and an antral preserving technique starting 5 cm from the pylorus (Group B).***

Results: ***Preoperative data showed mean BMI as 47.29±6.07 kg/m² in Group A and 49.03±6.59 kg/m² in Group B. Three months post-surgery, BMI decreased to 38.78±4.98 kg/m² in Group A and 41.19±5.53 kg/m² in Group B. At 6 months, further reductions were observed, with Group A at 32.96±4.23 kg/m² and Group B at 35.01±4.70 kg/m². Both groups exhibited significant BMI reductions from baseline to three months (P<0.001). There were no significant differences in the two groups' food tolerance scores at three and six months after surgery (P = 0.284 and P = 0.185, respectively).***

Conclusion: ***Both surgical techniques lead to significant weight loss and enhanced food tolerance without any significant differences in %EWL, BMI changes, or food tolerance among the groups. This indicates that the gastric resection distance from the pylorus in LSG does not significantly impact short-term outcomes in weight loss or food tolerance.***

Keywords: Body mass index; Excessive weight loss; food tolerance; obesity; Laparoscopic Sleeve Gastrectomy

1. Introduction

In the 21st century, obesity has developed into a significant health crisis, widely recognized as a critical threat to life.[1,2] It significantly contributes to increased mortality rates and is closely linked with numerous serious health conditions, such as hypertension, diabetes, and obstructive sleep apnea syndrome.[3,4]

The surgical approach for treating morbid obesity involves various procedures. The most prevalent surgical option in 2014 was sleeve gastrectomy, which accounted for almost 46% of procedures, closely followed by Roux-en-Y gastric bypass at around 40%, according to data from the International Federation for the Surgery of Obesity and Metabolic Disorders.[5,6] Laparoscopic sleeve gastrectomy (LSG) has proven its efficacy in both reducing weight and alleviating associated health issues.[7] Comparative studies have shown that weight loss results from LSG are on par with those from Roux-en-Y gastric bypass.8,9 The average reduction in excess weight post-LSG ranges between 60% and 75%, according to different studies. Long-term analysis reveals that this weight loss is sustained for 5 years or more after surgery, with an average excess weight loss above 50%.[8,9]

While LSG is a straightforward technique with established basic steps, there are ongoing debates among bariatric surgeons regarding specific technical aspects. These debated topics include the appropriate bougie size, the section's shape at the gastroesophageal junction, and whether the staple line has to be reinforced. Another area of contention concerns the extent of antrum removal, with the starting point of gastric transection varying greatly from 2 to 8 cm from the pylorus. Therefore, this study sought to assess food tolerance following LSG according to the distance of resection from the pyloric ring.

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2. Patients and methods

2.1.Design and Setting

This study was a prospective, randomized trial conducted at Al-Azhar University Hospitals. It spanned from May 2020 to December 2021 and involved fifty patients with morbid obesity, as defined by the Garrow classification. Each participant provided informed consent after providing a complete description of the procedure and research. Low molecular weight heparin was given preoperatively as a prophylactic measure against thrombosis. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine at Al Azhar University.

2.2.Participants

Eligible participants were adults with a BMI >40 kg/m² or a BMI >35 kg/m² with comorbidities such as hypertension, diabetes mellitus, co-arthritis, or obstructive sleep apnea syndrome. We omitted individuals with an American Society of Anesthesiologists (ASA) score of 4 or higher, history of upper gastrointestinal (GIT) surgery, pregnancy, or inability to commit to regular follow-up.

2.3.Interventions

Participants were randomly assigned to one of two LSG techniques:

Group A (Total Antral Sacrifice, 25 patients): Starting the stapler line 2 cm from the pylorus.

Group B (Antral Preserving, 25 patients): Starting the stapler line 5 cm from the pylorus.

2.4.Endpoints

Food tolerance and %EWL in both groups were assessed as the primary endpoints. Secondary outcomes included surgical time, duration of stay following surgery, mortality in the hospital, comorbidity resolution, and complications following surgery, such as leakage, internal haemorrhage, and wound complications.

2.5.Preoperative Assessment

Patients experienced a thorough before-surgery assessment, which included medical history and clinical examination, with anesthesiological risk assessment according to the American Society of Anesthesiologists classification. Dietary habits and previous weight loss attempts were also assessed.

2.6.Evaluation and treatment of comorbidities.

Preoperative tests: complete liver and renal function tests, routine blood screening, endocrine evaluation (including thyroid function), abdominal ultrasonography, upper endoscopy, esophageal manometry, electrocardiography (ECG), echocardiography, pulmonary function tests, and sleep studies for those with suspected sleep apnea.

2.7.Statistical Methods

Data were analyzed with the Statistical Package for Social Science (SPSS; IBM., Inc., Chicago; version 25). While mean and standard deviation (SD) were used to represent continuous data, frequencies and percentages were used to present categorical data. We used the Fisher Exact test or the Chi-square test to compare categorical data. Depending on the data's normality, continuous variable tests were compared using the independent T-test or the Mann-Whitney test. A p-value of < 0.05 has been deemed statistically significant.

3. Results

Demographic characteristics

The demographic comparison between Group A (2cm, n=25) and Group B (5cm, n=25) revealed no significant differences across various parameters. The gender distribution was closely matched, with Group A having 72.0% females and 28.0% males, compared to 76.0% females and 24.0% males in Group B, yielding a P-value of 0.747. Regarding age, Group A's participants had a mean age of 34.12±10.63 years, while Group B's mean age was slightly higher at 36.20±10.92 years, but this difference has not been statistically significant (P-value = 0.498). The mean weight in Group A was 131.56±26.85 kg, and in Group B, it was 133.84±16.11 kg, with a P-value of 0.717. Heights were comparable, with Group A averaging 166.16±10.29 cm and Group B at 165.60±8.46 cm, resulting in a P-value of 0.834. These similarities in demographic characteristics indicate a well-balanced comparison between the two groups, as shown in Table 1.

Table 1. Demographic characteristics

DEMOGRAPHIC DATA	GROUP A 2CM (N=25)	GROUP B 5CM (N=25)	P-VALUE
GENDER			
FEMALE	18 (72.0%)	19 (76.0%)	0.747
MALE	7 (28.0%)	6 (24.0%)	
AGE "YEARS"			
MEAN ± SD	34.12±10.63	36.20±10.92	0.498
WEIGHT (KG)			
MEAN ± SD	131.56±26.85	133.84±16.11	0.717
HEIGHT (CM)			
MEAN ± SD	166.16±10.29	165.60±8.46	0.834

Reduction in BMI

Preoperatively, the mean BMI in Group A was 47.29±6.07 kg/m2 compared to 49.03±6.59 kg/m2 in Group B, with no statistically significant difference (P= 0.336). After 3 months, Group A showed a reduction in mean BMI to 38.78±4.98 kg/m2, while Group B's mean BMI decreased to 41.19±5.53 kg/m2, also not significantly different (P= 0.112). At 6 months post-operation, Group A's mean BMI further decreased to 32.96±4.23 kg/m2, and Group B to 35.01±4.70 kg/m2, maintaining a similar pattern of non-significant difference (P= 0.112).

The mean difference (MD) in BMI between 3 months and baseline was -8.51±2.58 kg/m2 for Group A and -7.84±2.29 kg/m2 for Group B, both showing significant reductions (P<0.001 for both

groups). At this stage, Group A had a %EWL of 18.0%, whereas Group B had 16.0%. Between 6 months and baseline, the MD in BMI was -14.33±3.75 kg/m2 for Group A and -14.02±3.62 kg/m2 for Group B, again with significant reductions (P<0.001 for both). The %EWL at 6 months for Group A and Group B, respectively, is 30.3% and 28.6%, as shown in Table 2.

Table 2. Reduction in BMI

VARIABLES		GROUP A 2CM (N=25)	GROUP B 5CM (N=25)	P-VALUE
PREOPERATIVE		47.29±6.07	49.03±6.59	0.336
AFTER 3 MONTHS		38.78±4.98	41.19±5.53	0.112
AFTER 6 MONTHS		32.96±4.23	35.01±4.70	0.112
MD BETWEEN 3 MONTHS AND BASELINE	MD	-8.51±2.58	-7.84±2.29	0.093
	P-value	<0.001	<0.001	
	%EWL	18.0%	16.0%	
MD BETWEEN 6 MONTHS AND BASELINE	MD	-14.33±3.75	-14.02±3.62	0.314
	P-value	<0.001	<0.001	
	%EWL	30.3%	28.6%	

MD, mean difference; %EWL, percentage of estimated weight loss

Food Tolerance

Three months postoperatively, Group A exhibited a mean food tolerance score of 19.28±3.02 compared to 21.44±2.58 in Group B, with no statistically significant difference (P = 0.284). At the 6-month mark, the mean food tolerance score for Group A increased to 22.36±0.64 compared to 23.56±0.51 in Group B with no statistically significant difference (P = 0.185), as shown in Table 3.

Table 3. Comparison of food tolerance in Groups A and B

FOOD TOLERANCE SCORE	GROUP A 2CM (N=25)	GROUP B 5CM (N=25)	P-VALUE
POSTOPERATIVE AT 3M MEAN±SD	19.28±3.02	21.44±2.58	0.284
POSTOPERATIVE AT 6M MEAN±SD	22.36±0.64	23.56±0.51	0.185

Comorbidities Resolution

For hypertension (HTN), 64.0% in Group A and 68.0% in Group B no longer exhibited symptoms postoperatively (p=0.765). In the case of diabetes mellitus (DM), 72.0% of Group A and 68.0% of Group B showed resolution, with a similarly non-significant p-value of 0.758. Regarding obstructive sleep apnea syndrome (OSAs), 76.0% in Group A and 80.0% in Group B experienced resolution postoperatively (p-value = 0.733). Finally, for arthritis, 88.0% of Group A and 76.0% of Group B had no symptoms postoperatively (p-value = 0.269), as revealed in Table 4.

Table 4. Comparison of comorbidity resolution in Groups A and B

COMORBIDITY RESOLUTION	GROUP A 2CM (N=25)	GROUP B 5CM (N=25)	P-VALUE
HTN			
NEGATIVE	16 (64.0%)	17 (68.0%)	0.765
POSITIVE	9 (36.0%)	8 (32.0%)	
DM			
NEGATIVE	18 (72.0%)	17 (68.0%)	0.758
POSITIVE	7 (28.0%)	8 (32.0%)	
OSAS			
NEGATIVE	19 (76.0%)	20 (80.0%)	0.733
POSITIVE	6 (24.0%)	5 (20.0%)	
ARTHRITIS			
NEGATIVE	22 (88.0%)	19 (76.0%)	0.269
POSITIVE	3 (12.0%)	6 (24.0%)	

HTN, Hypertension ; DM, diabetes mellitus; OSA, obstructive sleep apnea syndrome

Operative Characteristics

The mean time of operation was slightly longer in Group A at 95.60±11.02 minutes compared to Group B at 91.20±9.05 minutes, but this difference wasn't statistically significant (P= 0.129). Regarding the number of staplers used during the surgery, Group A had a mean of 6.56±0.51, while Group B used slightly fewer, with a mean of 5.96±0.50 (p=0.198). The mean blood loss for both groups was comparable: Group A lost 91.60±11.61 ml, and Group B lost 87.80±7.08 ml on average, with a non-significant p-value of 0.169. The duration of stay in the hospital in days was similar for both groups; Group A had a mean stay of 2.36±0.49 days, and Group B had a mean of 2.52±0.51 days (P= 0.264), as displayed in Table 5.

Table 5. Operative characteristics

OPERATIVE DATA	GROUP A 2CM (N=25)	GROUP B 5CM (N=25)	P-VALUE
OPERATIVE TIME (MIN) MEAN ± SD	95.60±11.02	91.20±9.05	0.129
NUMBER OF STAPLERS MEAN ± SD	6.56±0.51	5.96±0.50	0.198
BLOOD LOSS (ML) MEAN ± SD	91.60±11.61	87.80±7.08	0.169
HOSPITAL STAY IN DAYS MEAN ± SD	2.36±0.49	2.52±0.51	0.264

Postoperative Complications

The conversion rate to open surgery was 8.0% in Group A, compared to 0.0% in Group B, with a P-value of 0.153. Gastric leaks occurred in 8.0% of Group A and 4.0% of Group B, showing no significant difference (P= 0.556). Postoperative bleeding was reported in 12.0% of patients in Group A, while no cases were reported in Group B (p=0.077). Notably, the overall complication rate was significantly higher in Group A at 28.0%, compared to just 4.0% in Group B (P = 0.022), as shown in Table 6.

Table 6. Postoperative complications

POST-OPERATIVE COMPLICATION	GROUP A: 2CM (N=25)	GROUP B: 5CM (N=25)	P-VALUE
TURN TO OPEN	2 (8.0%)	0 (0.0%)	0.153
GASTRIC LEAK	2 (8.0%)	1 (4.0%)	0.556
POSTOPERATIVE BLEEDING	3 (12.0%)	0 (0.0%)	0.077
OVERALL COMPLICATIONS	7 (28.0%)	1 (4.0%)	0.022

Gastrographine study

In both groups, the majority of patients (96.0% in Group A and 92.0% in Group B) received negative gastrographine study results. Positive results were found in a small minority, 4.0% in Group A and 8.0% in Group B (p=0.552), as shown in Figure 1.

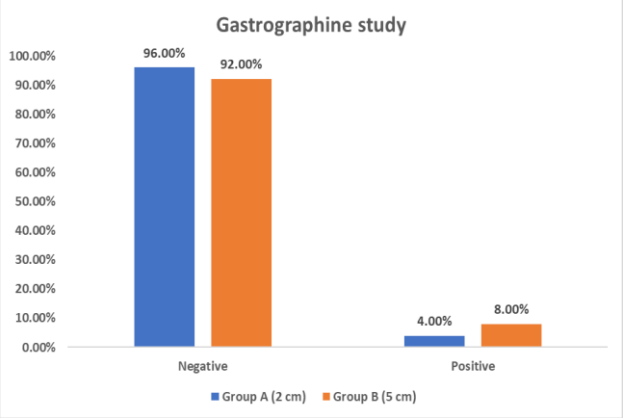

Figure 1. Results of Gastrographine Study

4. Discussion

LSG has grown in popularity as the most commonly performed procedure of surgery for managing morbid obesity, mainly due to its low complication rates and quick recovery, enabling patients to return to social and professional life swiftly. However, the technique for LSG is still under development, and several aspects remain controversial, particularly concerning the initiation point of gastric excision and the extent of excision from the pyloric antrum. There are divergent opinions among surgeons, with some advocating for a resection starting 2 cm from the pylorus for a more constrictive impact and potentially increased loss of weight.[10] In comparison, others recommend starting 5 cm from the pylorus to retain the antrum's contractility and promote better gastric emptying.[11] This study explored the differences in outcomes between two LSG techniques differing in the distance of resection from the pyloric ring. Our findings demonstrated that both surgical techniques effectively reduced BMI significantly over time, with no significant differences between the groups. This aligns with the findings of previous studies, which have established the efficacy of LSG in weight loss.[7,12] However, our study extends this understanding by showing that minor differences in the method, like the distance of resection from the pylorus, do not significantly impact the effectiveness of weight loss. Similarly, Hussein et al. compared the distance between 2 and 6 cm from the pylorus in LSG. Their findings showed that both surgical techniques effectively reduced BMI significantly over time, with no significant differences between the groups.[13]

A novel study tool was employed by Baumann et al.[14] to examine stomach motility in individuals undergoing antrum-preserving LSG. Their study, involving magnetic resonance imaging on five patients prior to and six months following surgery, found that keeping the antrum intact led to quicker antral gastric emptying as the sleeve lacked propulsive peristalsis. These findings challenge previous studies that indicated improved emptying of the stomach following total antral excision.[15] Conversely, Bernstine et al.[16] found no significant changes in emptying of the stomach in a prospective analysis of 21 patients who had an antrum-preserving technique, as measured by scintigraphy tests prior to and three months post-surgery. Proponents of antral conservation argue that it can reduce the chances of distal gastric blockage and potential leaks at the angle of His.[17] In contrast, those favouring antral resection close to the pylorus believe it results in a more restrictive sleeve, potentially leading to better weight loss outcomes.[10]

Recent studies have shown varying results regarding weight loss relative to the length of the antrum preserved. Obeidat et al.[18] reported slightly enhanced weight loss with complete antral resection at the two-year postoperative mark. Abdallah et al.[19] noted marginally better weight loss with increased antral resection volume. However, our study observed no significant weight loss differences between groups at the 3 and 6 months follow-up period, aligning with Garay et al.'s findings, who showed no significant variance in %EWL at one year post-LSG.[20]

Food tolerance improved over time in both groups, with no significant difference noted. This is a crucial aspect of postoperative recovery and patient satisfaction. The similarity in outcomes suggests that both techniques are equally viable in ensuring postoperative dietary adaptation. Khalifa et al. compared the antral resection and antral sparing LSG in terms of food tolerance. Their findings showed that the group that underwent antral sparing surgery demonstrated significantly improved food tolerance compared to the group with antral resection, both at the 3 and 6-month postoperative marks.[21]

Regarding the resolution of comorbidities, both groups showed significant improvement in conditions like HTN, DM, and OSA syndrome.

This is consistent with the broader body of literature, which supports the role of LSG in improving obesity-related comorbidities.[22] Similar to our findings, Hussein et al. reported resolutions of comorbidities in both groups throughout the period following surgery, with no statistically significant differences noted between the groups ($p > 0.05$).[13] This is consistent with Lakdawala et al.,[9] who reported significant resolutions in various conditions such as DM, HTN, and sleep apnea following 12 months and with Abdallah et al.,[19] who found high-resolution rates for HTN and obstructive sleep apnea syndrome. Brethauer et al.[23] also echoed similar findings, showing significant resolutions in DM, HTN, and sleep apnea post-LSG.

Operative characteristics, including operative time, number of staplers used, blood loss, and duration of stay in the hospital, were similar across the groups, reinforcing the notion that both techniques are comparable in terms of surgical feasibility and immediate postoperative results. The astrographic study results, indicating the integrity and function of the gastric sleeve post-surgery, were overwhelmingly negative (indicating no leakage) in both groups. This high success rate in both groups (96% in Group A and 92% in Group B) is a testament to the overall safety of the LSG procedure when performed by skilled surgeons.

However, a notable difference was observed in the overall complication rates, with Group A (2 cm resection) experiencing a significantly higher rate of complications compared to Group B (5 cm resection). This finding is particularly relevant for surgical practice, suggesting a potential advantage of the 5 cm resection technique in minimizing postoperative complications. This finding could guide future surgical decisions and patient counselling. Hussein et al. reported no intraoperative complications or postoperative deaths, with a 25% total complication incidence in both groups. This rate is comparable to findings from the American Society for Metabolic and Bariatric Surgery[24] and other literature reviews.[25] The variation in complication rates, such as bleeding and gastric leakage, aligns with the findings of Abdalla et al.,[19] who also noted differences based on the resection start point.

Limitations: This study has limitations. The sample size, though adequate for initial exploration, is relatively small, and the study is performed in a single centre, which could restrict the findings' generalizability. Additionally, the follow-up period was limited to 6 months postoperatively; longer-term studies would be beneficial to assess the sustained impact of these techniques. Further research is needed to confirm these results in larger, multicenter studies with longer follow-up durations. Additionally, exploring patient-reported outcomes and quality of life post-surgery would provide a more holistic understanding of the impact of these surgical techniques.

4. Conclusion

In conclusion, our study suggests that while both 2 cm and 5 cm resection distances in LSG are effective for weight loss, the 5 cm distance might be preferable due to its lower complication rates. This finding has significant implications for surgical practice, potentially influencing the choice of technique in LSG procedures. Future studies aim to replicate these results in larger and more diverse groups to validate them.

Disclosure

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