

Influence of staple line reinforcement on the occurrence of bleeding complications following laparoscopic sleeve gastrectomy: a retrospective analysis

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Abstract

Introduction: Laparoscopic sleeve gastrectomy (LSG) has gained prominence as a therapeutic option for obesity and metabolic diseases. The choice of staple line reinforcement technique in LSG remains a subject of debate, particularly concerning postoperative bleeding complications.

Aim: The aim of this retrospective analysis is to assess the influence of different staple line reinforcement techniques on the occurrence of bleeding complications LSG.

Material and methods: We conducted a retrospective analysis of patients undergoing LSG between September 2021 and April 2023 at our institution. Patients were stratified into two groups based on the staple line reinforcement method: continuous suturing ($n = 53$) and clipping ($n = 28$). Surgical outcomes, including operative time, length of hospital stay, and bleeding complications, were assessed. Complications were classified using the Clavien-Dindo classification.

Results: Continuous suturing was associated with a significantly longer operative time (88.15 min vs. 74.64 min, $p < 0.05$) but a similar length of hospital stay. Notably, no bleeding complications occurred in the continuous suturing group, while the clipping group experienced postoperative bleeding in 7.14% of cases ($p < 0.05$). Continuous suturing exhibited a slightly higher incidence of minor complications classified as Class I in the Clavien-Dindo classification (7.55% vs. 0%).

Conclusions: This retrospective analysis suggests that continuous suturing may provide enhanced hemostasis along the staple line, reducing the risk of postoperative bleeding compared to clipping. Despite the longer operative time and a slightly higher rate of minor complications, the clinical significance of these findings should be considered within the context of individual patient risk profiles.

Key words: staple line reinforcement, bariatric surgery, laparoscopic sleeve gastrectomy, bleeding complications, Clavien-Dindo classification, continuous suturing.

Introduction

The advent of minimally invasive surgical techniques has revolutionized the field of surgery, offering patients the benefits of reduced postoperative pain, shorter hospital stays, and quicker recovery times [1]. Within this paradigm, laparoscopic sleeve

gastrectomy (LSG) has gained prominence as an effective and safe procedure for the treatment of obesity and metabolic diseases [2–4]. However, despite its many advantages, LSG is not without its share of challenges, and postoperative bleeding remains a noteworthy concern [5].

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The integrity of the staple line in LSG is critical, as it plays a pivotal role in preventing complications, including bleeding, leakage, and strictures. The question of how best to reinforce this staple line has stirred debate within the surgical community. Various staple line reinforcement techniques, such as continuous suturing and clipping, have been employed to bolster the staple line's strength and minimize the risk of adverse events [6]. However, determining which approach offers superior protection against bleeding complications remains an ongoing challenge.

As LSG continues to be a primary surgical modality for addressing obesity and its associated comorbidities, a comprehensive understanding of the factors that impact its safety and efficacy is paramount. By investigating the role of staple line reinforcement in bleeding complications, this study endeavors to contribute valuable insights to the field of bariatric surgery.

Aim

The aim of this retrospective analysis is to assess the influence of different staple line reinforcement techniques on the occurrence of bleeding complications following laparoscopic sleeve gastrectomy. Our study compares two methods, continuous suturing and clipping, seeking to elucidate whether the choice of reinforcement technique holds a significant association with postoperative bleeding events. Our findings aim to inform surgical decision-making, empowering clinicians to optimize patient outcomes by selecting the most suitable technique for staple line reinforcement in laparoscopic sleeve gastrectomy.

Material and methods

Study design and setting

This study was designed as a retrospective observational analysis set in our surgical center, which strictly adheres to the recommendations by Szeliga *et al.* [7] and Nurczyk *et al.* [8]. The center provides comprehensive and specialized postoperative care. We reviewed clinical data of patients who underwent LSG between September 2021 and April 2023.

Participants

In line with the STROBE criteria for cohort selection, the cohort included patients diagnosed with

obesity who underwent LSG during the study period [9]. Inclusion was based on indications for bariatric surgery as detailed by Szeliga *et al.* [7]. Revisional procedures, particularly where LSG acted as a secondary or corrective bariatric procedure, were excluded [10].

Variables

Staying consistent with the STROBE guidelines, patients were categorized based on the staple line reinforcement technique [9]:

- Continuous suturing group: serosa to serosa suturing (3.0 V-lock 90, Medtronic, US).
- Clipping group: utilizing multiple clips.

Data sources/measurement

As per the STROBE guidelines, data were sourced from electronic medical records, surgical logs, and postoperative notes. Variables analyzed included:

- Demographic data: age, gender, and preoperative body mass index (BMI).
- Operative parameters: including the duration of the surgical procedure.
- Bleeding complications: evaluated through vital signs, clinical examination, and if necessary, diagnostic laparoscopy.
- Hospitalization length.
- Complications assessment: using the Clavien-Dindo classification system [11].

Bias

In alignment with STROBE's focus on bias minimization, potential biases were addressed through meticulous data collection from electronic medical records and a consistent categorization of the reinforcement techniques [9].

Study size

The cohort incorporated all eligible patients who underwent LSG within the designated timeframe.

Statistical analysis

Data analysis was performed using SAS Studio statistical software. Descriptive statistics, including means, standard deviations, and percentages, were computed for demographic and operative variables. The χ^2 test or Fisher's exact test was used to compare categorical variables between the two

reinforcement groups. Continuous variables were compared using the Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$.

Ethical considerations

This retrospective analysis was conducted in accordance with ethical principles and guidelines. Approval from the institutional ethics committee was obtained. Patient confidentiality and data privacy were rigorously maintained throughout the study. Informed consent was waived due to the retrospective nature of the analysis.

Results

Baseline characteristics

In our retrospective analysis, we examined the baseline characteristics of the study population, stratified by the method of staple line reinforcement utilized during laparoscopic sleeve gastrectomy. The two reinforcement groups, continuous suturing ($n = 53$) and clipping ($n = 28$), exhibited distinct demographic and physical profiles, as summarized below:

The mean age of 53 patients in the continuous suturing group was 41.13 years (standard deviation, SD 9.31). Patients in this group had an average body weight of 119.6 kg (SD 25.55). The mean height in this group was 168.73 cm (SD 9.66). The average BMI for patients in this group was 41.69 kg/m² (SD 6.17). Approximately 75.47% of patients in the continuous suturing group were female.

The number of patients in clipping group was 28. The mean age was 35.03 years (SD 8.63). Patients in this group had an average body weight of 118.12 kg (SD 11.78). The mean height in this group was 168.03 cm (SD 4.61). The average BMI for patients

in the clipping group was 41.81 kg/m² (SD 3.56). Most patients in the clipping group, approximately 96.43%, were female.

Differences in age and sex distribution were statistically significant (Table I).

Surgical outcomes

We evaluated surgical outcomes, comparing patients who underwent continuous suturing for staple line reinforcement ($n = 53$) with those where clipping was employed ($n = 28$). The mean duration of surgery for the continuous suturing group was 88.15 min (SD 16.5). In the clipping group, the mean surgical time was 74.64 min (SD 17.04). Notably, the difference in surgical duration between the two groups was statistically significant ($p < 0.05$), with continuous suturing requiring a longer operative time.

Patients in the continuous suturing group had an average hospital stay of 3.33 days (SD 0.478). In the clipping group, the mean hospitalization duration was 3.28 days (SD 0.71). There was no statistically significant difference in the length of hospital stay between the two groups.

In the continuous suturing group, no cases of postoperative bleeding were observed, resulting in a bleeding complication rate of 0%. Conversely, in the clipping group, postoperative bleeding occurred in 2 cases, representing a bleeding complication rate of 7.14% (Table II). This difference in the incidence of postoperative bleeding was statistically significant ($p < 0.05$), favoring the continuous suturing group with a lower rate of bleeding complications. In both groups we did not observe any case of leak or mortality.

These findings illuminate the distinct outcomes associated with the choice of staple line reinforcement technique. Continuous suturing was linked to

Table I. Baseline characteristics

Variable	Continuous suturing group $n = 53$		Clipping group $n = 28$	
	Mean	SD	Mean	SD
Age [years]*	41.13	9.31	35.03	8.63
Body weight [kg]	119.6	25.55	118.12	11.78
Height [cm]	168.73	9.66	168.03	4.61
BMI [kg/m ²]	41.69	6.17	41.81	3.559
Female (%)*	75.47		96.43	

SD – standard deviation, BMI – body mass index, * $p < 0.05$.

Table II. Surgical outcomes

Variable	Continuous suturing group <i>n</i> = 53		Clipping group <i>n</i> = 28	
	Mean	Std. dev.	Mean	Std. dev.
Operative time [min]*	88.15	16.5	74.64	17.04
Length of hospitalization [days]	3.33	0.478	3.28	0.71
Bleeding complications (%)	0		7.14	

**p* < 0.05.

Table III. Clavien-Dindo classification

Class (%)	Continuous suturing group <i>n</i> = 53	Clipping group <i>n</i> = 28
Clavien-Dindo:		
Class 0	92.45	92.86
Class I	7.55*	0
Class II	0	0
Class IIIA	0	0
Class IIIB	0	7.14*
Class IV	0	0
Class V	0	0

**p* < 0.05.

a longer operative duration but appeared to offer a protective effect against postoperative bleeding, as evidenced by the significantly lower bleeding complication rate in comparison to clipping.

Table III provides an overview of complications observed in patients undergoing LSG based on the Clavien-Dindo classification, stratified by the method of staple line reinforcement – continuous suturing and clipping.

- Class 0: In both groups, most patients experienced a normal postoperative course without complications, with 92.45% in the continuous suturing group and 92.86% in the clipping group falling into this category.
- Class I: Within the continuous suturing group, 7.55% of patients experienced minor complications (Class I), while no patients in the clipping group fell into this category, signifying a statistically significant difference (*p* < 0.05).
- Class II, IIIA, IIIB, IV, V: There were no instances of complications classified as Class II, IIIA, IV, or V in either group. However, in the clipping group, 7.14% of patients encountered moderate complications categorized as Class IIIB.

These findings reveal that, while most patients in both groups experienced an uneventful postoperative course (Class 0), the continuous suturing group had a slightly higher incidence of minor complications (Class I). Notably, the clipping group had a specific occurrence of moderate complications (Class IIIB).

Discussion

Obesity has emerged as a global epidemic in recent decades, presenting a significant public health challenge. Epidemiological studies have revealed alarming trends, with obesity rates steadily rising across the world [12, 13].

Sleeve gastrectomy has emerged as a widely accepted and effective bariatric procedure for weight loss and improving metabolic outcomes [2, 14]. This procedure involves the vertical transection of the stomach to create a tubular alimentary channel along the lesser curvature, resulting in reduced food intake, early satiety, and favorable hormonal changes. LSG has shown promising results, with a mean excess weight loss (EWL) of 43.5% (2.1–109.2%) after 10 years, making it a popular choice among patients and surgeons [15].

One of the key considerations in LSG is the reinforcement of the staple line, which aims to reduce postoperative complications such as bleeding [16]. Postoperative bleeding is a significant concern after LSG, with reported incidences around 4.02% [17]. It is essential to consider that bleeding complications after LSG can arise from various sources, including the gastric staple line, omentum, short gastric vessels, spleen, gastroepiploic artery, and abdominal wall. Therefore, the choice of staple line reinforcement technique should be considered cautiously, considering factors such as the surgeon’s experience, patient comorbidities, postoperative medications, and technical aspects [17].

One of the trade-offs associated with staple line reinforcement is a slightly longer operative time.

The meta-analysis found that staple line reinforcement was associated with a reasonable increase in operative time. However, this time prolongation is generally acceptable, with an average increase of around 15–16 min [18]. Surgeons should weigh this additional time against the potential benefits of reduced postoperative complications, which can lead to cost savings and improved patient outcomes in the long run.

The choice of staple line reinforcement technique in LSG has been a topic of significant interest and debate among bariatric surgeons. This study aimed to contribute to this ongoing discussion by comparing two commonly employed techniques: continuous suturing and clipping. Our findings shed light on the potential implications of these techniques for postoperative bleeding complications.

One notable finding was the significant difference in operative time between the continuous suturing and clipping groups. Continuous suturing required a longer mean operative time (88.15 min) compared to clipping (74.64 min). This result aligns with the expectation that suturing involves a more time-consuming process than clipping. While this difference was statistically significant, it should be interpreted in the context of clinical relevance. Twelve minutes difference is smaller than that reported previously [18]. Surgeons may prioritize factors other than operative time, such as bleeding risk, when choosing a reinforcement technique.

The length of hospital stay did not significantly differ between the two groups. This suggests that, despite the variation in operative duration, patients in both groups had comparable postoperative recovery trajectories and were discharged within a similar timeframe. The absence of a difference in hospital stay is a reassuring finding for clinicians and patients alike.

The primary focus of our study was to assess the occurrence of postoperative bleeding complications, a significant concern in LSG. Notably, the continuous suturing group exhibited a 0% incidence of bleeding complications, while the clipping group experienced postoperative bleeding in 7.14% of cases. This difference was statistically significant, favoring the continuous suturing technique. These results suggest that continuous suturing may offer superior hemostasis along the staple line, reducing the risk of postoperative bleeding.

Our findings corroborate some previous studies suggesting that continuous suturing may provide

better reinforcement of the staple line and enhance its ability to withstand hemodynamic stress during the postoperative period [18].

An important aspect of our study was the use of the Clavien-Dindo classification to assess postoperative complications. While both groups primarily fell into Class 0, indicating an uneventful postoperative course, the continuous suturing group had a slightly higher incidence of minor complications classified as Class I (7.55%), whereas no Class I complications were observed in the clipping group. This result may suggest that continuous suturing introduces a slightly higher risk of minor complications but is associated with a reduced risk of bleeding complications.

Interestingly, the clipping group exhibited specific occurrence of moderate complications categorized as Class IIIB (7.14%), which may warrant further investigation into the nature and causes of these complications. It is essential to consider the clinical significance and impact of these differences in complication rates within the context of overall patient outcomes.

In the contemporary landscape of bariatric surgery research, this study distinguishes itself by offering a meticulous exploration into the nuances of staple line reinforcement techniques in LSG. While there is a burgeoning volume of studies on obesity and LSG, few have delved into the comparison of continuous suturing versus clipping, particularly in the context of postoperative bleeding complications. Most studies lean heavily on standardized parameters such as operative time, postoperative pain, and length of hospital stay. However, our study goes beyond the norm by highlighting the intricacies associated with bleeding risk and its potential sources after LSG. The discovery of a 0% bleeding complication rate in the continuous suturing group compared to a 7.14% in the clipping group is indeed groundbreaking. The substantial difference in operative time, despite being in line with expectations, further cements this study's significance. It underscores that time efficiency does not necessarily equate to optimal patient outcomes, a paradigm shift from conventional surgical thinking. Moreover, the deployment of the Clavien-Dindo classification, a universally accepted system for grading postoperative complications, adds a layer of credibility and comparability to our findings. While the limitations inherent to retrospective analyses are recognized, the

novelty and implications of these findings cannot be understated, marking a pivotal contribution to the existing body of knowledge in bariatric surgery.

This study has several limitations, including its retrospective nature, the use of data from a single center, a relatively small sample size, and non-randomized allocation. These limitations should be acknowledged when interpreting the results and considering their generalizability.

Conclusions

Our study contributes to the ongoing discussion regarding the choice of staple line reinforcement technique in LSG. Continuous suturing, despite a longer operative time, appears to offer superior hemostasis and a reduced risk of postoperative bleeding compared to clipping. However, the clinical significance of these findings should be weighed against other factors, such as operative time and minor complications. Further research, including prospective studies with larger cohorts and longer follow-up periods, is warranted to validate these findings and provide more comprehensive guidance for surgeons in choosing the optimal staple line reinforcement technique for LSG. The decision should consider the individual patient's risk profile and clinical priorities.

Conflict of interest

The authors declare no conflict of interest.

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