Research Article

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# Effect of timing of cholecystectomy on weight loss after sleeve gastrectomy in morbidly obese individuals with cholelithiasis: a retrospective cohort study

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**Abstract**

**Objectives:** Obesity and gallbladder stone disease are strongly connected conditions. Nonetheless, the concomitant performance of cholecystectomy alongside sleeve gastrectomy remains contentious in individuals with asymptomatic gallstones. This study examines the impact of cholecystectomy timing on weight loss following sleeve gastrectomy.
**Methods:** A retrospective assessment was conducted on the records of 94 patients who underwent bariatric surgery from 2021 to 2025. The effect on weight loss (% EWL), insulin resistance, and other metabolic parameters was evaluated in patients who underwent concomitant cholecystectomy with sleeve gastrectomy, those who had cholecystectomy six months post-surgery, and those who received cholecystectomy prior to sleeve gastrectomy.
**Results:** Out of 94 patients, 29 (30.8 %) received concomitant cholecystectomy. It was established that patients who received late cholecystectomy experienced reduced complication rates, shorter hospital stays, and decreased operation times compared to other groups. Fasting glucose and insulin resistance levels were significantly reduced in the late group at the 3rd and 6th months, but they diminished at the 6th month in the contemporaneous group ($p<0.05$). The augmentation in EWL% was markedly superior in the late group relative to the other groups commencing from the third month ($p<0.05$).
**Conclusions:** Postponing the treatment of asymptomatic gallbladder disease after sleeve gastrectomy is both safe and may yield beneficial effects on weight reduction and insulin sensitivity.

**Keywords:** sleeve gastrectomy; cholecystectomy; timing; weight loss

## Introduction

Strategies for addressing obesity have emerged as a prominent research focus globally. Bariatric surgery has been demonstrated to be the gold standard for the most immediate and enduring treatment of obesity, effectively reducing obesity-related comorbidities in the long term [1].

The prevalence of gallbladder stone disease (GSD) in obese individuals is quintuple that of healthy individuals [2]. Moreover, GSD manifests in roughly 30–40 % of patients who undergo bariatric surgery within the initial six months [3, 4]. This may be attributed to the presence of two risk factors in persons undergoing this surgery: obesity and quick weight loss. Consequently, GSD treatment is crucial for obese individuals.

A consensus on the management of GSD during bariatric surgery remains elusive. Certain authors advocate for conducting bariatric surgery without cholecystectomy in patients with asymptomatic GSD, as it decreases morbidity and length of hospital stay [5, 6]. Nevertheless, in this instance, prospective GSD problems and a subsequent operation may necessitate rehospitalization. In light of these issues, several articles have indicated that concomitant cholecystectomy (CC) is safer and more cost-effective [7–9]. Although CC during bariatric surgery has been

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discussed in numerous clinical studies and meta-analyses, these studies have evaluated the risks of complications, overall cost concerns, and additional treatment needs. This study approaches this general perspective from a different perspective, focusing on the impact of cholecystectomy timing on postbariatric outcomes by considering the gallbladder's ameliorative effects on glucose metabolism.

Despite cholecystectomy being one of the most prevalent surgical interventions globally, there remains contention on its metabolic consequences. The prevalence of heightened insulin resistance in people post-cholecystectomy indicates that the gallbladder exerts physiological influences on insulin sensitivity [10]. The increasing data concerning the gallbladder's role in insulin homeostasis prompts inquiries about its influence on weight loss following bariatric surgery. Currently, there is no evidence in the literature to substantiate this claim.

This study sought to examine the impact of cholecystectomy timing on weight reduction and insulin resistance in patients who underwent bariatric surgery for GSD. The metabolic consequences of cholecystectomy timing were assessed in obese patients with asymptomatic GSD.

## Materials and methods

This research is a retrospective observational study utilizing prospective data collected over four years at a single tertiary referral hospital. The research received approval from the hospital ethics committee (document number: 2025/63, date: 18 January 2025). The research was performed in compliance with the 1964 Helsinki Declaration and its subsequent revisions or comparable ethical norms. Data from patients who underwent laparoscopic sleeve gastrectomy (LSG) between January 2021 and 2025 were analyzed. Data from surgeons who had performed bariatric surgery at the same hospital for at least 5 or more years were included in the study. The timing of cholecystectomy was determined by the surgeon's own preference. Therefore, the timing of cholecystectomy was not affected by demographic or clinical characteristics.

Patients who had cholecystectomy for GSD before bariatric surgery and were diagnosed with GSD during the preoperative assessment were included in the study. Patients were categorized into three groups: Previous: individuals who underwent cholecystectomy previous to bariatric surgery; Concomitant: individuals who underwent cholecystectomy simultaneously with bariatric surgery; Late: individuals who underwent cholecystectomy 6 months or more after bariatric surgery due to symptomatic gallstone disease.

All patients were adults (≥18 years of age). All participants received a preoperative multidisciplinary assessment and satisfied the National Institutes of Health (NIH) consensus criteria for metabolic and bariatric surgery (MBS), specifically a body mass index (BMI) of ≥40 $kg/m^2$, or a BMI of ≥35 $kg/m^2$ accompanied by one or more obesity-related medical conditions.

The primary endpoint of the study was weight loss and therefore the %EWL parameter, while the secondary endpoint was the effects of glucose on the HOMA-IR score, which is a parameter of insulin sensitivity.

The study comprised patients having preoperative hepatobiliary ultrasonography reports. The exclusion criteria encompassed any previous metabolic and bariatric surgery (e.g., LSG), advanced organ failure (liver, kidney, or heart), malignancies, acute inflammatory or infectious diseases, administration of ursodeoxycholic acid during the post-bariatric period, and patients with incomplete medical records or those who could not be contacted. The patients were categorized into three groups based on the timing of cholecystectomy. Prior to bariatric surgery, concurrent cholecystectomy, and more than six months post-bariatric surgery. The demographic information of patients with comorbidities (diabetes, hypertension, dyslipidemia, hypothyroidism, and sleep apnea); pre-operative biochemical parameters (fasting blood glucose, insulin, cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), alanine transaminase (ALT), aspartate transaminase (AST); HOMA-IR score, weight, and percentage of excess body weight loss (%EWL) prior to and at 1, 3, and 6 months post-surgery. Patients' weight, EWL%, and HOMA-IR score were assessed. The total percentage of excess weight loss (EWL%) was computed as follows: (preoperative weight–desired body weight) * 100. The HOMA-IR score is calculated by multiplying the fasting glucose level by fasting insulin and dividing the result by 405. The optimal body weight was determined using a standard BMI of 25 $kg/m^2$.

## Data analysis

For numerical variables, the mean and standard deviation or median (Q1-Q3) values are presented, but for categorical variables, the frequency and percentage values are provided. Chi-square or Fisher's exact tests were employed for the study of categorical data, and ANOVA or mixed effects models (where HOMA-IR included as a covariate) were utilized for the analysis of numerical variables. In multiple comparisons, least squares means were analyzed used Tukey adjusted. The parameters evaluated in the study were evaluated at a 95 % confidence interval. In the models, group, time, and the group × time interaction were defined as fixed effects, while individuals were defined as random effects. F tests were reported for main effects, and effect sizes were calculated using partial eta squared ($\eta^2$p). Effect size was reported using Cohen's d in significant comparisons. Analyses were conducted utilizing the R 4.5.1 software (R Core Team, 2024). A p-value of less than 0.05 was deemed statistically significant.

## Results

Table 1 presents the analysis of demographic data of patients categorized by groups. The predominant demographic among the 94 patients in the study was female, comprising 91.4 % of the cohort. No mortality, reoperation, or conversion to open surgery occurred in any of the cohorts. Postoperative hemorrhage at the staple line was noted in 4 individuals (4.25 %). One patient (1.06 %) necessitated a blood transfusion. During the extended follow-up, a trocar hernia was identified in one patient (1.06 %). The duration of the operation and hospital stay was markedly reduced in the late group patients relative to the other groups (p<0.05).

Figure 1 displays the laboratory analyses of the patients. No significant differences were seen between the groups regarding total cholesterol, triglycerides, HDL, LDL, AST, and ALT levels. substantial reductions were noted in all levels except HDL when compared to preoperative values, while HDL exhibited a substantial rise after 6 months (p<0.01).

Figure 2 summarizes the fasting glucose and HOMA-IR readings of the patients. The contemporaneous group exhibited a notable reduction in fasting glucose levels at 6 months relative to preoperative values (p=0.003), but the late group demonstrated significant decreases at both 3 and 6 months compared to preoperative values (p=0.004 and p=0.007, respectively). Nonetheless, in the preceding group, no significant difference was seen over time in comparison to preoperative values (p=0.931). Accordingly, in the Concomitant and Previous groups, changes between Preop and subsequent months had mostly small to small-medium effects, while in the Late group, comparisons between Preop–3rd month (d=0.44) and Preop–6th month (d=0.44) showed medium-sized effects (Figure 2).

Figure 3 illustrates the impact of cholecystectomy timing on weight and excess weight loss (EWL). While no change in EWL levels was noted between groups at 1 month, a significant rise was seen in the late group compared to the prior group at 3 months (p=0.003). At six months, a notable rise was seen in the late group compared to both the prior and concurrent groups (p=0.000, p=0.032, respectively). The increase in EWL levels between the concurrent and prior groups was consistent across all months (p>0.05).

## Discussion

In the surgical management of morbid obesity, cholecystectomy is still commonly favored in individuals with asymptomatic gallbladder stones, despite the ambiguity surrounding

**Table 1:** Demographic data of patient groups.

| | **Concominant (N 29) Mean ± SD** | **Previous (N 41) Mean ± SD** | **Late (N 24) Mean ± SD** | **p-Value** |
|---|---|---|---|---|
| Age | 37.41 ± 10.62 | 41.02 ± 12.16 | 33.75 ± 11.32 | 0.060 |
| Sex | | | | |
| Female | 26 (90 %) | 41 (100 %) | 19 (79 %) | **0.006** |
| Male | 3 (10 %) | 0 (0 %) | 5 (21 %) | |
| BMI, kg/m2 | 46.75 ± 6.88 | 47.02 ± 6.13 | 45.80 ± 5.71 | 0.192 |
| Complication | Bleeding (1)<br>Trocar hernia (1) | Bleeding (3) | None | |
| Hospital stay/day | 3.21 ± 0.46 | 2.78 ± 0.32 | 2.1 ± 0.20 | **0.042** |
| Operation time/min | 98 ± 14.5 | 75 ± 12.84 | 52 ± 12.45 | **0.012** |

N: Patient number, SD:Standard Deviation BMI:Body Mass Index, Min:Minute,kg:kilogram, m:meter. [1]One-way analysis of means (not assuming equal variances); Chi-square or Fisher's exact test. p<0.05 indicates statistical significant.

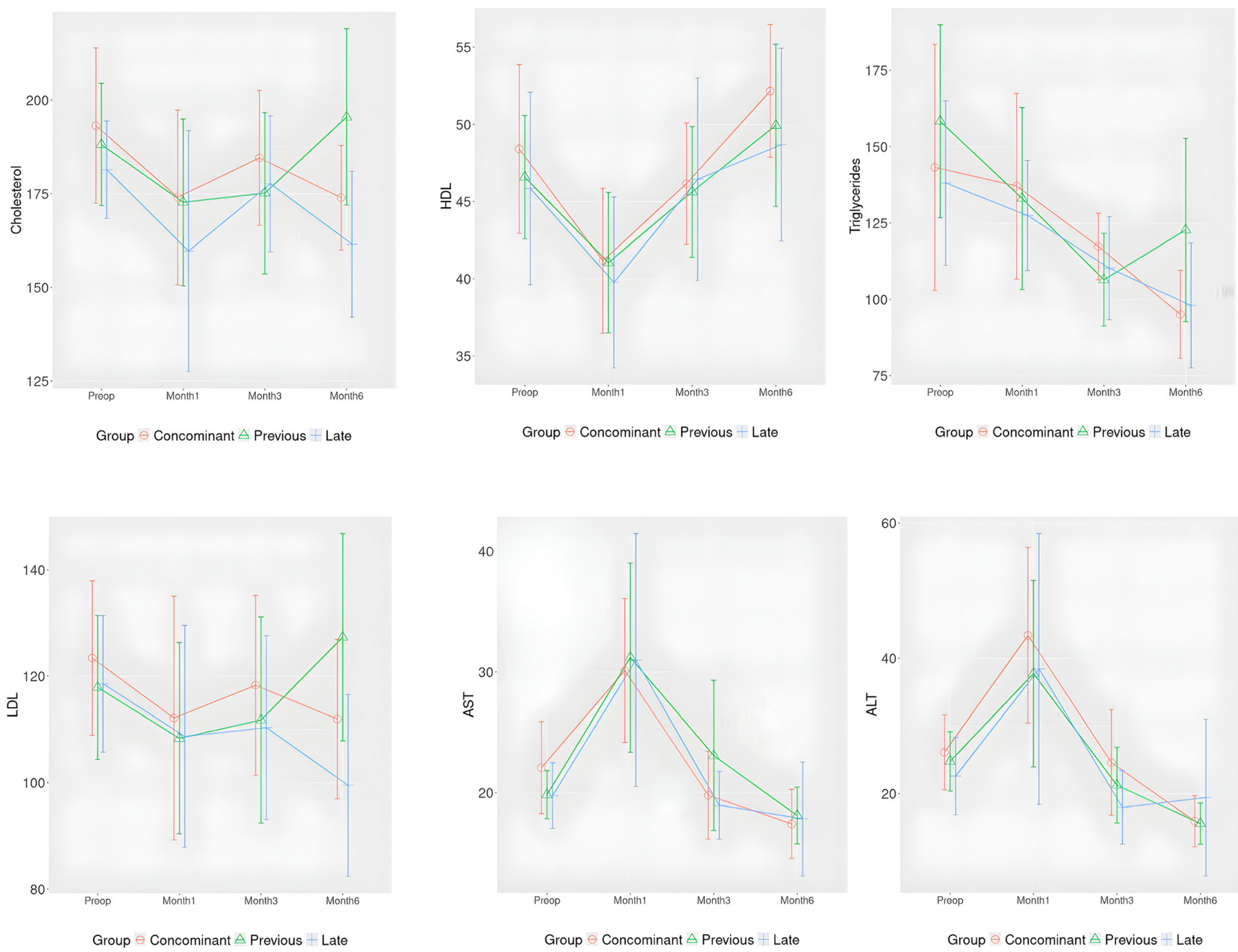


**Figure 1:** Laboratory parameters means of both groups with 95 % confidence interval during postoperative follow-up. HDL: High density lipoprotein, LDL: Low density lipoprotein, AST: Aspartate aminotransferase, ALT: Alanin aminotransferase.

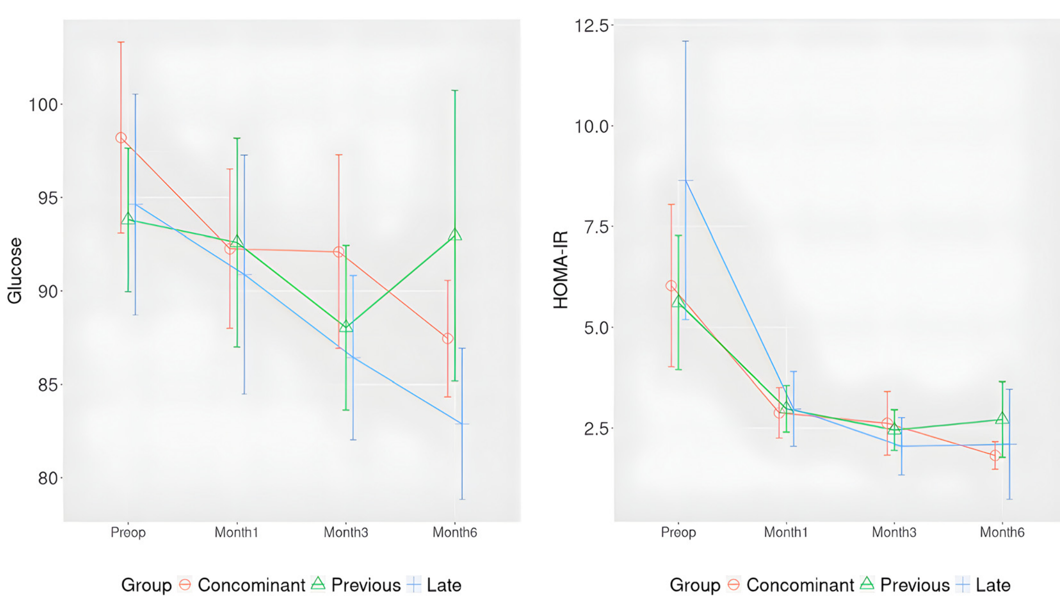


**Figure 2:** Changes in fasting glucose and HOMA IR scores means of both groups with 95 % confidence interval during postoperative follow-up. The main effect of time was large ($\eta^2$p=0.315), the main effect of group was insignificant ($\eta^2$p=0.011), and the group time interaction was small to moderate ($\eta^2$p=0.052) for HOMA-IR score.

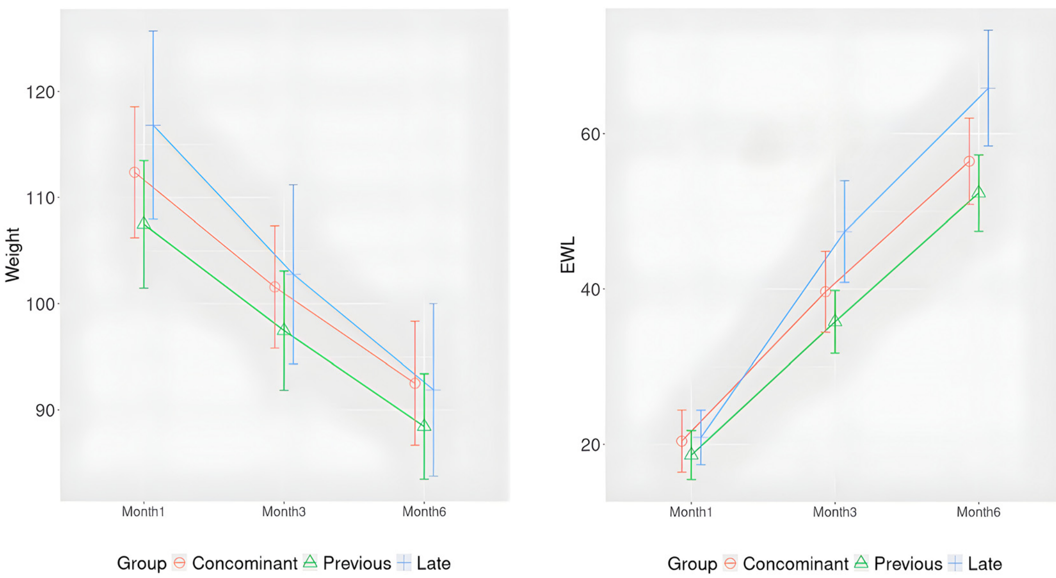


**Figure 3:** Comparison of weight loss and EWL levels means of both groups with 95 % confidence interval in postoperative follow-ups. For EWL, the main effect of time was very strong ($\eta^2$p=0.877), the effect of group was small to moderate ($\eta^2$p=0.087), and the group x time interaction was medium in size ($\eta^2$p=0.110). EWL%: Excess weight loss.

its necessity. Some studies highlight its potential to avert future procedures due to GS, while others indicate prolonged operational time and elevated complication rates without conclusive postoperative benefits. Advocates of simultaneous cholecystectomy assert that it is preferable to obviate the necessity for reoperation, given the potential problems linked to GSD and the tolerable rise in operative duration and complication rates [11, 12].

At now, 67.4 % of surgeons continue to choose CC [13]. A recent systematic review by Soares and colleagues indicated that the CC procedure results in a substantial increase in postoperative bleeding; patients undergoing this procedure experienced a markedly higher incidence of reoperation and postoperative complications, including wound, anastomotic, and respiratory issues [14]. Conversely, Raziel et al. indicated that 4 out of 43 patients (9.3 %) and Sioka et al. noted that 3 out of 23 patients (13 %) had symptoms necessitating cholecystectomy following LSG [15, 16]. Furthermore, in the most extensive investigation on bile duct injury subsequent to cholecystectomy, the incidence of such injuries was determined to be 1.1 %. While this percentage may appear minimal, it is regarded as relevant due to its potential to result in mortality following biliary surgery. Proponents of this perspective contend that CC is superfluous; they assert that in the future, only a minimal proportion of symptomatic GSD would necessitate surgical intervention, hence facilitating safer procedures by mitigating complications associated with obesity.

All current debates concentrate on the potential hazards linked to CC complications. Nevertheless, no prior research has examined the impact of the gallbladder on weight loss following bariatric surgery. In our study, we assessed the impact of the gallbladder on weight loss during the therapy period in asymptomatic gallbladder disease. Prior research indicates that the gallbladder plays physiological functions in glucose, lipid, and energy homeostasis, and that cholecystectomy results in insulin resistance [10]. Insulin resistance is a critical factor influencing weight reduction following sleeve gastrectomy. We expected that insulin resistance (IR) resulting from cholecystectomy would adversely impact weight loss. This study aims to assess gallbladder function in morbidly obese patients scheduled for surgery and diagnosed with asymptomatic gallstone disease. The primary aim of our study was to assess the gallbladder's role in postoperative weight loss and to offer an additional rationale against doing cholecystectomy based on this notion. The results indicated a notable weight reduction and EWL rates favoring patients who did not have cholecystectomy (Figure 3). In our study, we designated patients with a history of cholecystectomy previous to surgery as the control group. This enabled us to ascertain that the timing of cholecystectomy and the gallbladder's influence on weight reduction were substantial, even with asymptomatic stones present.

Our findings showed a significant decrease in glucose levels in individuals undergoing advanced cholecystectomy; however, the lack of a significant change in insulin resistance contradicts the existing literature. This result may be due to two factors: a) The late cholecystectomy group coincidentally included patients with higher HOMA-IR scores.

Although no significant difference in insulin resistance levels was found between the groups, a greater decrease in preoperative HOMA-IR scores was observed in the late group (Figure 2). This result suggests that: a) The preoperative HOMA-IR score in the late group was significantly higher than in the other groups. However, it decreased to the mean levels of the other groups in the postoperative period. This may have reduced the statistical significance of the HOMA-IR calculations. b) Insulin resistance is not only associated with obesity but is also influenced by many physiological mechanisms (non-alcoholic fatty liver disease, sex hormones, gut microbiota, fat cell-associated chronic inflammation, etc.). Since the patients in this study were not examined for these physiological factors, the inconsistency in HOMA-IR scores may be due to the influence of these factors.

When assessed from an alternative viewpoint, asymptomatic GSD rarely becomes symptomatic. Doulamis et al. report that the rate of gallstone formation following bariatric surgeries may reach 35 %, however only one-third of these instances necessitate surgical intervention [17]. Thus, asymptomatic gallstones also rarely become symptomatic. Indeed, a multitude of articles has been published regarding the beneficial effects of ursodeoxycholic acid in the treatment of freshly developed gallstones [18]. Consequently, surgeons adopting a CC attitude can mitigate anticipated gallstone problems by managing patients pharmacologically instead of proceeding with cholecystectomy.

To our knowledge, no prior study has documented the post-operative blood values in patients following cholecystectomy after LSG. In a comparable study analyzing the metabolic characteristics of patients who received CC vs. those who did not, Machado et al. concluded that patients who did not undergo CC exhibited superior changes in lipid profile, fasting glucose, HbA1c, and insulin levels [19]. Our study examined preoperative fasting blood sugar, total cholesterol, triglycerides, HDL, LDL, ALT, and AST, revealing no statistically significant changes between the groups in both univariate and multivariate analyses. The absence of notable enhancements in these parameters in our study may be attributed to the non-preservation of the duodenum in gastric bypass procedures, facilitating the rapid transit of bile acids to the ileum and their subsequent absorption.

Proponents of concurrent cholecystectomy assert that it entails comparable surgical durations and complications (8). In our study, the surgical durations and hospital stay of patients with a history of cholecystectomy prior to CC and LSG were significantly longer compared to those in the late group. Despite statistical significance, the overall number of complications in our study is weaker due to the low number of complications.

Our limitations apply to all retrospective observational studies, as extended follow-up and homogeneous cohorts are necessary for a more accurate assessment of the proposed outcomes. Furthermore, the study's power analysis was limited by the low incidence of symptomatic cholecystectomy after bariatric surgery.

## Conclusions

The study advises against CC because of the gallbladder's beneficial impact on weight loss, with asymptomatic GSD, surgical durations, and complication risks in people undergoing LSG.

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**Informed Consent Statement:** Since this study was designed as a retrospective file review, informant consent forms were not obtained from the patients.

**Authors Contribution:** RSK and SK: Conceived and designed the study, data collection, paper write-up, and the compilation of the results. AYS and AGD: Data collection, paper write-up. RSK and MYK: Data collection, discussion, statistical analyses, SK and AYS: discussion, and proofreading, RSK: Data collection, discussion.

**Conflicts of Interest:** The authors declare no conflicts of interest.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author due to ethical reasons.

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