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Case Report

Analysis of Factors Affecting the Occurrence of Gallbladder Stones After Laparoscopic Sleeve Gastrectomy: A Single-Center Retrospective Study

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Abstract

Background: Postoperative gallstone formation is a significant complication following Laparoscopic Sleeve Gastrectomy (LSG). However, the risk factors and prevention strategies are not yet fully understood. This study aimed to investigate the risk factors for gallstone formation after LSG and provide insights into their prevention and management.

Methods: A single-center retrospective study was conducted on patients who underwent LSG at our hospital between June 2015 and June 2023. The study included patients diagnosed with obesity and met the indications for LSG. Data on patient characteristics, surgical procedures and postoperative follow-up were collected and analyzed using SPSS26.0. Binary logistic regression was utilized to evaluate the impact of various factors on the occurrence of gallstones after LSG.

Results: A total of 172 patient records were collected for this study. After excluding patients with preoperative gallbladder stones, those who underwent cholecystectomy and those who did not complete regular follow-ups, a final sample of 140 patients was included. The average age was 31.59±7.94 years, with a mean preoperative weight of 110.84±24.41 kg and a mean preoperative BMI of 39.58±7.37 kg/m². The average operation time was 74.6±20.0 minutes and the average hospital stay was 7.1±2.9 days. Binary logistic regression analysis revealed that Excess Weight loss at 6 months (EWL6) was a risk factor for post-LSG gallstone formation ($P<0.05$), while age, gender, BMI, EWL12, TWL6, TWL12, hypertension, diabetes, degree of hepatic steatosis, presence of duodenal ulcer inflammation and presence of gastritis were not identified as risk factors for gallstone formation after LSG ($P>0.05$).

Conclusion: This study identified excess weight loss at 6 months as a significant risk factor for gallstone formation after LSG. Further research is needed to explore the underlying mechanisms and develop effective prevention and management strategies for postoperative gallstone formation in patients undergoing LSG.

Keywords: Laparoscopic Sleeve Gastrectomy; Gallbladder Stones; Cholecystectomy; Metabolic Disorders

Introduction

The prevalence of obesity in China is steadily rising, posing a significant threat to people's health [1]. Laparoscopic Sleeve Gastrectomy (LSG) is a common weight loss surgery that has been widely adopted for addressing obesity and its associated metabolic disorders [2]. However, certain studies have indeed pointed out a potential increase in the incidence of gallstones among patients undergoing LSG surgery. Research suggests that the composition of bile might undergo changes after LSG surgery. One study indicate that LSG surgery can reduce the synthesis of bile acids [3,4]. De Vuono S has noted that LSG surgery may decrease markers related to cholesterol synthesis), which could lead to the release of cholesterol metabolites within the body. This could raise the concentration of cholesterol in bile, thereby promoting the formation of gallstones.

The primary objective of this study is to comprehensively analyze the post-operative incidence of gallstones following

laparoscopic sleeve gastrectomy through a single-center retrospective investigation, while also exploring potential contributing factors. By identifying these factors, we aim to assist patients in timely prevention or management of post-operative gallstone complications.

Data and Methods

Study Design

A retrospective analysis was performed on patients who underwent laparoscopic sleeve gastrectomy at the Hospital between June 2015 and June 2023.

Inclusion Criteria: (1) Patients diagnosed with obesity who met the indications for laparoscopic sleeve gastrectomy and underwent the procedure; (2) Patients who underwent regular follow-ups after surgery, with complete clinical data and imaging examination results; (3) Patients who provided informed consent and signed relevant consent forms.

Exclusion Criteria: (1) Patients with gallstones or a history of gallbladder removal prior to surgery; (2) Patients with severe cardiopulmonary dysfunction, liver and kidney abnormalities or other complications that rendered them unable to tolerate surgery; (3) Patients with a history of mental illness or intellectual impairment, making postoperative follow-up impossible; (4) Patients who did not adhere to post-surgical lifestyle modifications, such as diet and exercise; (5) Patients who were lost to follow-up or had incomplete data.

A comprehensive one-year follow-up study was conducted on the 140 patients. Abdominal color Doppler ultrasound examinations were performed at 1, 3, 6 and 12 months after the operation.

Data Collected Included:

1. Clinical data: Basic information such as age, gender, body mass index and co-existing diseases of the patients
2. Surgical records: Information on surgical approaches, operative duration and surgical complications.

For patients who developed gallstones after the operation, additional data related to gallstones were collected, including the time of gallstone discovery, percentage of Total Weight Loss (%TWL) and percentage of Excess Weight Loss (%EWL) at the time of gallstone discovery and the size, number and location of the gallstones

Surgical Technique

After anesthesia, sterilize and drape the operative area. Make a 1 cm incision above the navel, puncture with a 10mm trocar for CO_2 insufflation and insert a laparoscope. Place a 12 mm trocar 10 cm right of the navel and a 5 mm trocar 10 cm left, below the xiphoid process. Use atraumatic forceps to shield the left liver lobe. With an ultrasound scalpel, dissect along the greater curvature of the stomach from 1.5 cm left of the His angle to 4 cm from the pylorus. Insert a 36F gastric tube orally. At 5 cm from the pylorus, use a laparoscopic stapler to respect the greater curvature, creating a tube-like gastric cavity of about 100ml. Suture the stomach's incised edge with absorbable sutures. Remove the excised tissue through the 12 mm trocar. Confirm no active bleeding, deflate CO_2, remove trocars and close incisions.

Data Analysis Methods

The study data were analyzed and processed using the statistical software SPSS 26.0. Continuous variables were expressed as mean ± standard deviation. Binary logistic regression was utilized to evaluate the effects of various factors on the occurrence of gallstones after laparoscopic sleeve gastrectomy in the study subjects. The Box-Tidwell method was employed to test for linearity between continuous independent variables and the logit-transformed dependent variable. Collinearity was assessed using the Variance Inflation Factor (VIF) to remove any multicollinearity factors. A significance level of $P<0.05$ indicated statistical significance. The %TWL was calculated as: (initial weight minus follow-up weight/initial weight) × 100. To calculate the %EWL, we used the following equation: amount of weight loss/excess body weight × 100. Excess body Weight (EW) was calculated according to a BMI of 25 kg/m^2: basal weight-(25*height$_2$).

Results

Participant Characteristics

A total of 172 patient records were collected for this study. Among them, 10 patients were confirmed to have gallbladder stones

or polyps preoperatively, 10 patients underwent cholecystectomy and 12 patients did not complete regular follow-ups. Ultimately, 140 patients were included in the study, with 51 males and 99 females. The average age was 31.59±7.94 years, average preoperative weight was 110.84±24.41 kg and average preoperative BMI was 39.58±7.37 kg/m^2. All patients successfully underwent Laparoscopic Sleeve Gastrectomy (LSG) without major surgical complications such as bleeding or gastric leakage. The average operation time was 74.6±20.0 minutes and the average hospital stay was 7.1±2.9 days (Table 1).

A binary logistic regression was used to evaluate the impact of various factors on the occurrence of gallbladder stones after laparoscopic sleeve gastrectomy in the study participants. The results indicated that Excess Weight Loss at 6 months (EWL6:[(Initial Weight - Postoperative weight at 6 months) / (Initial Weight - Ideal Body Weight)] * 100%) was a risk factor for post-LSG gallstone formation ($P<0.05$), while age, gender, BMI, EWL12, TWL6, TWL12, hypertension, diabetes, degree of hepatic steatosis, presence of duodenal ulcer inflammation and presence of gastritis were not identified as risk factors for gallstone formation after LSG ($P>0.05$) (Table 2).

Discussion

In this study, gallstone formation was observed in 32 out of 140 patients (22.9%) during a 1-year follow-up after laparoscopic sleeve gastrectomy. The results indicated that only the Excess Weight Loss at 6 months (EWL6) was associated with the development of gallstones, while other parameters were not found to be valuable in predicting the occurrence of gallstones. The incidence rate of cholecystolithiasis or gallstone formation, after Laparoscopic Sleeve Gastrectomy (LSG) reported in various studies is approximately 20.7% which are consistent with our research [5].

The pathogenesis of gallbladder stones after laparoscopic sleeve gastrectomy involves several factors. The rapid weight loss following LSG can lead to changes in bile metabolism and composition. The decreased intake of nutrients and reduction in gallbladder emptying may result in the supersaturation of bile with cholesterol, promoting the formation of gallstones [6]. Additionally, the altered enterohepatic circulation of bile acids after LSG can further contribute to the development of gallstones by affecting bile composition and gallbladder function [7,8]. Excess Weight Loss (EWL) at 6 months, as identified in the study, was associated with the development of gallstones after LSG. This may be attributed to the rapid weight loss leading to changes in bile composition and cholesterol saturation, facilitating the formation of gallstones. Other factors such as age, gender, BMI, EWL at 12 months, presence of comorbidities like hypertension and diabetes, liver steatosis, duodenal ulcer inflammation and gastritis were not found to be significant predictors of gallstone occurrence in this study.

Research on the influencing factors of the onset of gallstones after Laparoscopic Sleeve Gastrectomy (LSG) includes factors such as rapid weight loss, changes in bile composition, gall bladder motility, genetic predisposition, etc. However, the conclusions drawn from different studies may vary. One study showed a higher incidence of gallstones at 12 months after weight loss [9]. Another meta-analysis identified Caucasian race and female sex are risk factors for developing cholelithiasis after bariatric surgery while weight loss ratio was not [10]. There are also studies indicating a significant correlation between preoperative hypertension and coronary artery disease with the occurrence of postoperative gallstones [11].

Taking the oral Ursodeoxycholic Acid (UDCA) to prevent the occurrence of gallstones after laparoscopic sleeve gastrectomy is a common practice in clinical settings. Several studies have explored the efficacy of UDCA in preventing gallstones after bariatric surgery, including laparoscopic sleeve gastrectomy. A meta-analysis concluded that the prophylactic use of UDCA after bariatric surgery significantly reduced the incidence of gallstones and gallbladder-related complications [12]. Another study published in Obesity Surgery in 2020 found that UDCA was well-tolerated and effective in preventing gallstones in patients undergoing bariatric surgery [13]. Two studies recommend routine oral administration of ursodeoxycholic acid within six months after weight loss surgery. In our clinical practice, we conduct abdominal ultrasound examinations on weight loss patients at one, three, six and twelve months postoperatively. If sediment accumulation is detected in the gallbladder, ursodeoxycholic acid is only administered for prevention, rather than routine prophylaxis. Through this treatment approach, for patients without gallstones before surgery but who develop sediment in the gallbladder postoperatively, a follow-up abdominal ultrasound is performed three to six months after taking ursodeoxycholic acid. The sediment-like stones in the gallbladder have disappeared in these patients and no cases of acute cholecystitis have occurred.

When severe obesity patients are found to have concurrent gallstones before surgery, the need for primary gallbladder resection

during surgery depends on multiple factors, including the patient's symptoms, the condition of gallstones and surgical risks. Some studies suggest that simultaneous cholecystectomy during weight loss surgery can be beneficial for severely obese patients with gallstones to prevent complications in the future, such as cholecystitis and gallbladder rupture. One study published found that for patients undergoing bariatric surgery, simultaneous cholecystectomy was associated with a lower rate of subsequent postoperative complications related to gallstones compared to delayed cholecystectomy. The study concluded that performing cholecystectomy at the same time as weight loss surgery could reduce the overall surgical risk and avoid the need for additional surgeries in the future [14]. However, another study showed that the risk of de novo symptomatic gallstone disease after bariatric surgery is not substantially high. It is still arguable if prophylactic cholecystectomy is a fitting approach for patients with a preoperative lithiasic gallbladder [15].

Limitations of the study encompass its concentration on a single center, the limited patient cohort and the retrospective study design.

Conclusion

In summary, the incidence of gallstone formation after laparoscopic sleeve gastrectomy is notable. Regular postoperative follow-up is necessary and for patients experiencing rapid weight loss, oral ursodeoxycholic acid treatment should be considered to prevent the formation of gallstones.

Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contribution

All of the authors participated in the design, execution and analysis of the paper and approved the final version.

Compliance with Ethical Standards

This study is retrospective and therefore no consent form is needed.

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