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STUDY PROTOCOL

Postoperative Thirst After Laparoscopic Sleeve Gastrectomy: An Observational Study Protocol Investigating Incidence and Associated Factors

Jing Sang[1,*], Guanyu Yang[1,*], Liumei Li[1], Jiayao Tian[2], Zhentao Sun[3], Qinjun Chu[1]

[1]Department of Anesthesiology and Perioperative Medicine, Zhengzhou Central Hospital Affiliated to Zhengzhou University, Zhengzhou, Henan, People's Republic of China; [2]The First Clinical Medical College, Lanzhou University, Lanzhou, Gansu, People's Republic of China; [3]Department of Anesthesiology, Pain and Perioperative Medicine, the First Affiliated Hospital of Zhengzhou University, Zhengzhou, Henan, People's Republic of China

*These authors contributed equally to this work

Correspondence: Zhentao Sun, Department of Anesthesiology, Pain and Perioperative Medicine, the First Affiliated Hospital of Zhengzhou University, No. 1 Jianshe East Road, Zhengzhou, Henan, 450052, People's Republic of China, Tel +8613603455483, Email fccsunzt@zzu.edu.cn; Qinjun Chu, Department of Anesthesiology and Perioperative Medicine, Zhengzhou Central Hospital Affiliated to Zhengzhou University, Tongbai North Road 16, Zhengzhou, Henan, 450007, People's Republic of China, Tel +8613643711142, Email jimmynetchu@163.com

Introduction: Postoperative thirst is a common yet under-investigated issue following metabolic and bariatric surgery (MBS), such as sleeve gastrectomy (SG), despite its significant impact on patient comfort and recovery. While studies in other surgical fields report a high prevalence of this distressing symptom, its incidence and predictors remain unquantified in the MBS population. This study aims to prospectively determine the incidence of postoperative thirst (primary outcome), the incidence of moderate-to-severe thirst, and the factors associated with postoperative thirst (secondary outcomes) in adults undergoing SG.

Methods: This prospective, single-center, observational cohort study will enroll adults (age ≥18, ASA class 2–3) undergoing elective SG. Based on a preliminary incidence of 90% from a 10-patient pilot study, we plan to enroll 180 patients. The primary outcome—incidence of postoperative thirst—will be assessed immediately upon arrival in the post-anesthesia care unit using the Numeric Rating Scale (NRS), with thirst defined as an NRS score ≥ 1. Moderate-to-severe thirst will be defined as an NRS score ≥4. We will collect demographic, perioperative, and intraoperative data to investigate factors potentially associated with postoperative thirst. A two-stage analytical approach will be employed: variable selection using Least Absolute Shrinkage and Selection Operator (LASSO) regression, followed by multivariable binary logistic regression to identify factors associated with postoperative thirst.

Discussion: The findings from this protocol will clarify the epidemiology of postoperative thirst in MBS and help identify modifiable perioperative risk factors. This evidence will inform nursing practices and the optimization of postoperative care pathways, supporting better recovery and comfort for individuals undergoing MBS. Results are intended to provide a basis for further interventional studies and contribute to improved perioperative management in MBS.

Trial Registration: Registered at the Chinese Clinical Trial Registry on May 9, 2025. Trial Registration Number: ChiCTR2500102147.

Keywords: metabolic and bariatric surgery, sleeve gastrectomy, postoperative thirst, incidence, factors

Introduction

Obesity has emerged as a global public health crisis, with incidence rates escalating annually and posing a significant threat to human health.[1] Metabolic and bariatric surgery (MBS) has gained widespread clinical acceptance in recent years as the only effective intervention currently capable of achieving sustained short-term and long-term weight loss, ameliorating metabolic comorbidities, and reducing mortality rates.[2] Laparoscopic sleeve gastrectomy (LSG) is currently the most commonly performed MBS procedure worldwide.[2] Individuals with obesity often present with underlying metabolic disorders, including insulin resistance and chronic low-grade inflammation, as well as alterations in water-electrolyte balance regulation.[1,2] Given these physiological characteristics, it is notable that several aspects of postoperative management after MBS have not been

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given sufficient attention, and among these, postoperative thirst is a critical factor affecting patient comfort and quality of recovery.[3]

Postoperative thirst is not only a subjective discomfort experienced by patients but also potentially reflects changes in their metabolic state, water and electrolyte balance, and stress response.[4] Furthermore, it is crucial to consider that postoperative thirst can be a symptom of serious complications, such as staple line bleeding or leak, which may occur in the immediate postoperative period or later within 2–3 days after SG.[5,6] However, the prevalence and intensity of postoperative thirst even in the absence of such complications remain poorly characterized. Lee et al's study showed that the incidence of postoperative thirst in a general surgical population was as high as 79.6%, with moderate-to-severe thirst accounting for 53.2%–69.8%.[3] This phenomenon not only affects patients' postoperative experience but may also increase the risk of secondary complications such as dehydration and electrolyte disturbances, thereby prolonging hospital stays and reducing quality of life.[7,8] However, systematic research on postoperative thirst in individuals undergoing MBS remains relatively scarce, and its underlying mechanisms and related influencing factors have not been thoroughly investigated.

To address this gap, the present study will prospectively investigate postoperative thirst in adults undergoing SG. The primary objective is to determine the incidence of postoperative thirst. The secondary objectives are (a) to identify factors associated with the occurrence of any thirst, and (b) to identify factors associated with the occurrence of moderate-to-severe thirst. Based on established pathophysiology and evidence from other surgical populations,[3,4,7,8] we will focus on a comprehensive set of potential factors encompassing patient characteristics (eg., gender, body mass index), preoperative preparations (eg., fasting duration), intraoperative management (eg., fluid balance, use of anticholinergic drugs), and immediate postoperative state (eg., pain, body temperature).

We anticipate that this investigation will hold substantial clinical relevance. Through a rigorous and systematic approach, the patterns of postoperative thirst can be elucidated, and evidence-based postoperative nursing protocols can be developed for clinical healthcare providers. The implementation of such protocols is anticipated to enhance the patient's surgical experience and promote improved recovery outcomes. Moreover, the findings of this study are expected to provide a theoretical framework for the optimization of perioperative management in MBS. Ultimately, these improvements are expected to contribute positively to enhanced surgical safety and improved patient prognoses.

Methods

Study Objective

We aim to (1) determine the incidence of postoperative thirst assessed immediately upon arrival in the post-anesthesia care unit (PACU) in awake patients (Ramsay sedation score ≤3) undergoing SG and (2) identify its associated factors, thereby generating hypotheses for preventive interventions.

Study Design

Prospective, single-center, observational cohort adhering to the STROBE checklist.

Ethical Considerations

This study was approved by the Institutional Review Board of Zhengzhou Central Hospital Affiliated to Zhengzhou University (Ethics Approval Number: ZXYY2025044, date: 19 March 2025) and registered with the Chinese Clinical Trial Registry (Registration Number: ChiCTR2500102147, date: 9 May 2025). The study protocol was conducted in accordance with the ethical principles of the Declaration of Helsinki. Prior to any data collection, written informed consent will be obtained from all participants.

Participants

Inclusion criteria: Age ≥18 years, American society of Anesthesiologists (ASA) class 2–3 (consistent with the typical ASA grading of patients with obesity undergoing LSG, who often present with associated metabolic comorbidities),[1,2] undergoing elective SG under general anesthesia, and transferred to PACU postoperatively; Exclusion criteria: Pregnancy, postoperative Ramsay sedation score >3, postoperative altered consciousness, experience of major intraoperative or postoperative

complications (eg., significant bleeding requiring transfusion or re-intervention, staple line leak) prior to PACU assessment, mental or neurological diseases, refusal to participate.

Recruitment

Participants will be recruited from the MBS Department at the Zhengzhou Central Hospital Affiliated to Zhengzhou University. All patients scheduled to undergo SG will be screened for eligibility. Eligible individuals who express initial verbal consent will be approached by research staff and provided with a written informed consent form. Potential participants will have the study explained to them, and any questions regarding the research will be addressed. To ensure sufficient time for review and family discussion, participants will not be required to make an immediate decision. Written informed consent will be obtained from all participants by research staff prior to the commencement of surgical procedures.

Perioperative Surgical Management

According to our institutional protocol for MBS, all patients followed a specific low-carbohydrate, high-protein preoperative diet before surgery: vegetables and high-protein foods for breakfast and lunch, and only vegetables for dinner.

All MBS procedures were performed by a dedicated and highly experienced surgical team. This team has collectively performed over 4000 MBS procedures, ensuring a high level of expertise and procedural consistency.

The SG procedure was performed according to a standardized technique. Briefly, pneumoperitoneum was established to 12 mmHg via a supraumbilical incision. Under laparoscopic guidance, two additional working ports were placed in the right, and left upper abdomen. A systematic exploration of the abdominal cavity was first conducted. The greater omentum was then divided starting from a point approximately 4 cm proximal to the pylorus, using an ultrasonic energy device, and continued along the greater curvature up to the His angle. A 36Fr bougie was inserted transorally to calibrate the gastric sleeve. Gastric transection was performed using multiple firings of a linear stapler, commencing 4 cm from the pylorus and continuing to the gastric fundus (approximately 1.5 cm from the His angle). The staple line was routinely oversewn with a continuous absorbable barbed suture for hemostasis and reinforcement. Finally, the resected stomach was extracted through the umbilical port site, and the fascial incisions were closed.

Perioperative Anesthetic Management

All patients underwent SG exclusively via the laparoscopic approach. They were required to fast for 8 hours and abstain from clear liquids for 2 hours prior to the procedure. No premedication was administered. Upon arrival in the operating room, standard monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP) measurement, and pulse oximetry (SpO_2), was initiated. An intravenous line was established in the upper extremity. Patients were then positioned in the lateral decubitus position, and a paravertebral nerve block was performed. Preoxygenation with 100% oxygen was administered, followed by anesthetic induction using sufentanil, propofol, and rocuronium. After endotracheal intubation, mechanical ventilation was initiated. Anesthesia was maintained intraoperatively with a balanced technique of intravenous and inhaled anesthetics.

Fluid management followed a standardized institutional protocol. Given that LSG is a mature and minimally invasive procedure at our center, typically lasting 1–2 hours and without routine urinary catheterization, the total intraoperative fluid administration was routinely maintained between 1000 mL and 1500 mL. The fluid administered was exclusively crystalloid (Lactated Ringer's solution) for all patients. Intravenous norepinephrine was continuously infused as needed to maintain blood pressure within the target range (±20% of baseline).

At the conclusion of the surgery, neuromuscular blockade was reversed with sugammadex, and patients were extubated and transferred to the PACU. Postoperative fluid management in the PACU involved maintaining a patent intravenous access with a minimal keep-vein-open rate. Postoperative analgesia was provided via patient-controlled intravenous analgesia (PCIA) for all patients. According to our enhanced recovery after surgery (ERAS) protocol for MBS, patients were allowed to commence oral intake of clear fluids approximately 2 hours after their arrival on the surgical ward, following confirmation of the absence of nausea, vomiting, or other contraindications.

Data Collection

Following the provision of written informed consent, baseline patient data were collected. Intraoperative data were then gathered from the patients' anesthesia records. Upon arrival in the PACU, patients underwent assessment for both Ramsay sedation score and level of consciousness.[9] The Ramsay sedation score as follows: 1 = patient is anxious, agitated, or restless; 2 = patient is cooperative, oriented, and tranquil; 3 = patient responds to commands only; 4 = patient exhibits a brisk response to a light glabellar tap or loud auditory stimulus; 5 = patient exhibits a sluggish response to a light glabellar tap or loud auditory stimulus; 6 = patient exhibits no response to stimulus. Thirst status was evaluated at this time point only if a Ramsay sedation score of ≤ 3 was recorded and no alteration in the patient's level of consciousness was observed.

All data were initially documented on paper-based Case Report Forms. To ensure accuracy, data were then entered into Excel and subjected to a double-entry verification process.

Measures

Independent Variables

We will investigate a comprehensive set of potential factors associated with postoperative thirst based on previous literature in other surgical populations and clinical plausibility.[3,4,7,8] The independent variables to be collected and analyzed include: Gender, age, body mass index (BMI), ASA classification, comorbidities (diabetes, hypertension), smoking (within three months), alcohol consumption (within three months), preoperative use of glucagon-like peptide-1 receptor agonists (GLP-1 RA), preoperative fasting duration, preoperative fluid restriction duration, intraoperative use of anticholinergic drugs, surgical duration, infusion volume, body temperature at the end of surgery (analyzed as a continuous variable), Numeric Rating Scale (NRS, 0–10) pain score upon arrival at the PACU.

Dependent Variable

Thirst was defined as the sensation and symptoms associated with the desire to drink water, as well as the feeling of dryness in the mouth and throat.[10] Postoperative thirst was assessed using the Numeric Rating Scale (NRS), a validated tool ranging from 0 (no thirst) to 10 (most intense thirst).[11,12] Consistent with previous studies in surgical populations,[11,12] thirst intensity was categorized as no thirst (0), mild thirst (1–3), moderate thirst (4–6), and severe thirst (≥7). For the primary outcome (incidence of postoperative thirst), we defined the binary dependent variable as any thirst (NRS ≥ 1). For the secondary outcome (incidence of moderate-to-severe thirst), we defined the binary dependent variable as moderate-to-severe thirst (NRS ≥ 4). These a priori definitions align with established thresholds in the literature.[11,12]

Primary Outcomes

The incidence of postoperative thirst among patients undergoing MBS.

Secondary Outcomes

1. The incidence of moderate-to-severe thirst in individuals undergoing MBS postoperatively;
2. The influencing factors of thirst in individuals undergoing MBS postoperatively. The factors to be evaluated include a comprehensive set of preoperative, intraoperative, and anesthetic-related variables (detailed in the Measures section);
3. The influencing factors of moderate-to-severe thirst in individuals undergoing MBS postoperatively. The same set of potential factors listed for outcome (2) will be investigated.

Data Analysis

Data analysis will be performed using R software (version 4.5.1). A p-value of less than 0.05 will be considered to indicate statistical significance. The Shapiro–Wilk test will be employed to assess normality. Normally distributed continuous variables will be presented as mean ± standard deviation, and comparisons between groups will be conducted using an unpaired *t*-test. Non-normally distributed continuous variables will be presented as median (interquartile range), and the Mann–Whitney *U*-test will be utilized for between-group comparisons. Categorical variables will be presented as

counts (percentages), and group comparisons will be performed using the Chi-squared test or Fisher's exact test, as appropriate.

Variable selection will be performed using Least Absolute Shrinkage and Selection Operator (LASSO) regression with 10-fold cross-validation, and the lambda value that minimizes the cross-validated deviance (lambda.min) will be selected to identify the most relevant predictors from all candidate variables. Subsequently, the selected variables will be entered into a multivariable binary logistic regression model to calculate adjusted odds ratios (ORs) with 95% confidence intervals (CIs).

Sample Size

In a preliminary assessment of ten patients who underwent LSG, a postoperative thirst incidence of 90% was observed. Based on this observed incidence, a sample size calculation was performed using G*Power version 3.1.9.7. With a set alpha of 0.05 (Z = 1.96) and an acceptable margin of error of 5% (e = 0.05), the calculated required sample size was determined to be 171 participants. To account for a projected attrition rate of 5%, a final sample size of 180 participants was determined.

To ensure that the final sample size is adequate for the planned multivariable logistic regression analysis, we applied the events-per-variable (EPV) rule. With approximately 15 candidate predictors and an anticipated thirst incidence of 90%, the expected number of events (patients with thirst) is approximately 162 (180 × 0.9). This yields an EPV of approximately 10.8 (162 events/15 predictors), which exceeds the commonly recommended minimum of 10 events per variable,[13] ensuring stable estimates and adequate statistical power for the multivariable analysis.

Discussion

The present protocol describes a prospective, observational cohort study that will systematically investigate the incidence and influencing factors of postoperative thirst in patients undergoing SG. As the first specialized study to focus on postoperative thirst in the MBS population, this research addresses a notable knowledge gap in enhanced recovery practices for individuals with obesity—a population at unique metabolic and physiological risk.

Based on established pathophysiology and evidence from other surgical populations, we anticipate that several specific factors will be significantly associated with postoperative thirst in our cohort undergoing SG. Prolonged preoperative fasting and fluid restriction are strongly hypothesized to be key contributors, as they directly lead to a state of relative hypovolemia and dehydration, drying the oral mucosa and triggering thirst sensation.[14,15] Intraoperative factors are also expected to play a critical role. The use of anticholinergic drugs can inhibit salivary secretion, causing xerostomia (dry mouth) which is a major component of thirst.[3] Furthermore, a longer surgical duration may correlate with increased insensible fluid loss and a prolonged exposure to anesthetic agents that affect fluid balance.[12] Elevated core body temperature (eg., >37.5°C) at the end of surgery, even if subfebrile, can intensify fluid loss through perspiration and elevate the thirst drive.[11] While some evidence suggests a potential influence of gender, recent meta-analyses have been inconclusive,[16] highlighting the need for further investigation in specific surgical populations like MBS. Other patient and perioperative variables collected in this study will be explored to build a comprehensive model of thirst predictors in this unique patient group.

By establishing the real-world incidence of postoperative thirst and identifying associated risk factors in an MBS cohort, our study aims to provide foundational evidence to support targeted perioperative interventions and improved patient-centered care after SG.

If successful, this research has practical implications in several areas—first, by quantifying the true burden of post-operative thirst, the study may prompt routine assessment and management of thirst as a standard vital sign in MBS recovery pathways. Second, identification of modifiable risk factors may inform updates to perioperative management protocols. For instance, if intraoperative fluid volume is identified as a protective factor, this would support the optimization of fluid administration strategies to mitigate thirst while maintaining hemodynamic stability. If the use of anticholinergic drugs is associated with increased thirst, this would encourage more judicious use of such agents or the selection of alternatives. If pain intensity is identified as a contributing factor, this would reinforce the importance of effective multimodal analgesia in reducing thirst. Additionally, if specific patient subgroups (eg., those with diabetes or using GLP-1 RAs) are found to be at

higher risk, this would support targeted preventive strategies. These actionable insights could inform the development of evidence-based, MBS-specific nursing guidelines to enhance postoperative comfort and recovery.

Limitations

Owing to its single-center, observational design, generalizability will require validation in broader MBS cohorts. As with most prospective cohort studies, the results may be subject to residual confounding. Furthermore, our study has several important methodological limitations. First, the assessment of postoperative thirst relies on a patient-reported outcome (the NRS) rather than an objective physiological measurement. Although the NRS is a validated and widely used tool for quantifying thirst intensity, this inherently subjective measure may be influenced by individual perception and reporting bias. Second, the absence of a control cohort (eg., patients undergoing other surgical procedures or receiving a specific thirst intervention) limits our ability to make direct comparative inferences about the absolute burden of thirst attributable to SG within the MBS population. Third, our assessment of thirst was conducted at a single time point (upon arrival in the PACU). While this captures the immediate postoperative state—a critical period for early symptom management—it does not capture the potential persistence or development of thirst later in the recovery period. Future studies with serial assessments (eg., at 6, 12, and 24 hours postoperatively) would be valuable to understand the full trajectory of postoperative thirst. Fourth, our measure of intraoperative fluid management was limited to infusion volume rather than comprehensive fluid balance (eg., estimated blood loss, urine output, insensible losses), which may not fully capture the physiological complexity of perioperative fluid status. Finally, thirst is influenced by complex physiological and psychological processes, and some variables (eg., thirst perception, stress response) may be imperfectly measured despite our standardized approach.

Conclusions

This study will provide the first systematic data on the incidence of postoperative thirst after SG and identify modifiable risk factors. The findings will inform targeted, evidence-based interventions to enhance recovery protocols and improve patient comfort in this population by clarifying the epidemiology of this distressing symptom.

Trial Status

Recruitment of participants commenced in July 2025 and is expected to be completed by May 2026. As of the current date (manuscript submission), participant enrollment is ongoing according to the planned timeline.

Data Sharing Statement

No datasets were generated or analysed during the current study.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Review Board of Zhengzhou Central Hospital Affiliated to Zhengzhou University (Ethics Approval Number: ZXYY2025044). Written informed consent will be obtained from all participants.

Author Contributions

Jing Sang: Conceptualization, methodology, project administration, formal analysis, writing – original draft, and writing – review & editing. Guanyu Yang: Conceptualization, methodology, project administration, formal analysis, writing – original draft, and writing – review & editing. Liumei Li: Methodology, project administration, and writing – review & editing. Jiayao Tian: Methodology and writing – review & editing. Zhentao Sun: Conceptualization, methodology, project administration, supervision, writing – original draft, and writing – review & editing. Qinjun Chu: Conceptualization, methodology, project administration, supervision, writing – original draft, and writing – review & editing. All authors gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

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Disclosure

The authors declare no competing interests.

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