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Original Article

Effect of Pre-Operative Intravenous Dextrose on Pain, Nausea and Vomiting After Laparoscopic Cholecystectomy

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) is a frequent and distressing complication following laparoscopic cholecystectomy, affecting up to 75% of patients and contributing to delayed recovery and patient dissatisfaction. While pharmacologic prophylaxis is standard, adjunctive strategies such as perioperative carbohydrate administration remain incompletely defined despite their physiologic rationale. Objective: To evaluate the effect of perioperative intravenous dextrose on the incidence, severity, and rescue treatment requirements for PONV in patients undergoing elective laparoscopic cholecystectomy. Methods: In this single-center randomized controlled trial, 180 adult patients (ASA I–II, 18–40 years) scheduled for elective laparoscopic cholecystectomy under standardized anesthesia were randomized to receive either 500 mL Ringer's lactate (Group A) or 500 mL Ringer's lactate with 5% dextrose (Group B), infused over 30 minutes beginning 30 minutes prior to surgery completion. PONV severity was assessed using the Bellville score at 1, 3, 6, 12, and 24 hours postoperatively. Blood glucose levels were measured at baseline and 30 minutes post-infusion. Results: Group B demonstrated a significantly lower overall PONV incidence (24.4% vs. 80.0%; p<0.001), reduced mean Bellville scores at 3 hours (1.07±0.25 vs. 1.40±0.86; p=0.025), and reduced rescue antiemetic use (8.9% vs. 33.3%; p=0.004). Transient hyperglycemia occurred in Group B but normalized within 24 hours without exceeding 200 mg/dL. Conclusion: Perioperative intravenous dextrose significantly reduces PONV incidence and severity and lowers rescue antiemetic requirements without clinically significant hyperglycemia, supporting its safe and effective role as adjunctive prophylaxis in laparoscopic cholecystectomy.
Keywords: postoperative nausea and vomiting, dextrose, laparoscopic cholecystectomy, randomized controlled trial, intravenous fluids

INTRODUCTION

Postoperative nausea and vomiting (PONV) represents a significant and frequent complication following surgical procedures, with a particularly high incidence reported in laparoscopic surgeries such as laparoscopic cholecystectomy (1). Despite advances in anesthetic techniques, approximately 40–75% of patients undergoing laparoscopic interventions experience PONV (2). This distressing complication contributes not only to postoperative discomfort but also to delayed recovery, prolonged hospital stays, increased healthcare costs, and decreased patient satisfaction (3). Several risk factors have been identified for PONV, including female gender, history of motion sickness or PONV, nonsmoking status, opioid use, and the type and duration of surgery (4). The pathophysiology of PONV is multifactorial, involving complex interactions between neurotransmitter systems, surgical stress, anesthetic agents, and patient-specific factors (5). Therefore, identifying effective and safe prophylactic strategies remains an important area of research.

Current pharmacologic strategies for PONV prevention include 5-HT3 receptor antagonists, corticosteroids, and dopamine antagonists, often used in combination; however, these agents carry potential side effects such as sedation, dysphoria, hypotension, and extrapyramidal symptoms (6). Moreover, there is a growing interest in perioperative interventions that could reduce PONV risk by modifying physiologic factors associated with nausea and vomiting, such as perioperative hydration status and insulin resistance (7). Emerging evidence suggests that perioperative carbohydrate administration may attenuate postoperative insulin resistance and improve patient comfort, potentially reducing PONV incidence (8). Intravenous dextrose, in particular, has attracted interest due to its capacity to mitigate fasting-induced hypoglycemia and dehydration, which may exacerbate postoperative nausea through vagal pathways, gastric acid secretion, and impaired gastric motility (9). The mechanism by which dextrose exerts this effect likely involves its osmotic properties reducing gastrointestinal muscle contractions and its influence on autonomic tone (10). Furthermore, fasting and intraoperative pneumoperitoneum during laparoscopic cholecystectomy contribute to gastric mucosal hypoperfusion, and adequate perioperative hydration, especially with carbohydrate-containing fluids, may reduce this risk and subsequently decrease PONV incidence (11).

Despite this plausible physiologic rationale, the literature remains inconclusive. Several randomized controlled trials (RCTs) and meta-analyses have reported conflicting results regarding the effect of perioperative intravenous dextrose on PONV, with some studies demonstrating significant reductions in PONV incidence (12), while others report minimal or no benefit (13). Methodological heterogeneity—including differences in patient populations, surgical procedures, timing, concentration, and volume of dextrose administered—complicates the interpretation of available evidence (14). A recent meta-analysis suggested that intravenous dextrose might reduce postoperative nausea but acknowledged substantial heterogeneity and the need for more targeted studies focusing on high-risk surgeries such as laparoscopic cholecystectomy (15). This inconsistency underscores a knowledge gap, particularly regarding the optimal timing, dosage, and patient selection criteria for intravenous dextrose administration in the context of PONV prophylaxis.

Given that laparoscopic cholecystectomy is associated with a particularly high incidence of PONV and that patient-centered care increasingly emphasizes enhanced recovery and early discharge protocols, identifying an effective, simple, and safe intervention to reduce PONV is of paramount importance. Prior studies have not consistently controlled for surgical and anesthetic confounders or focused on a homogenous patient population undergoing laparoscopic cholecystectomy, further justifying this investigation. Addressing this gap is crucial to inform perioperative management protocols that could improve patient outcomes, reduce reliance on pharmacologic antiemetics, and enhance recovery pathways.

Therefore, this study aims to evaluate whether the intraoperative administration of 500 mL of intravenous dextrose administered 30 minutes before the conclusion of surgery reduces the incidence and severity of PONV and decreases the requirement for rescue antiemetics compared to Ringer's lactate in adult patients undergoing elective laparoscopic cholecystectomy under standardized anesthetic conditions. The primary research question is: Does perioperative intravenous dextrose infusion reduce the incidence and severity of postoperative nausea and vomiting in adult patients undergoing laparoscopic cholecystectomy?

MATERIAL AND METHODS

A randomized controlled trial was conducted to evaluate the effect of perioperative intravenous dextrose administration on postoperative nausea and vomiting (PONV) in patients undergoing elective laparoscopic cholecystectomy. The study was carried out at the Department of Surgical Unit-II, Lahore General Hospital, Lahore, Pakistan, from 26 September 2022 to 27 March 2023. This setting was selected because of its high surgical volume, standardized perioperative protocols, and availability of trained anesthesia and surgical teams ensuring methodological consistency. The rationale for employing a randomized controlled design was to minimize allocation bias and allow for causal inference regarding the intervention's effect on PONV.

Eligible participants included adult patients aged 18 to 40 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective laparoscopic cholecystectomy under general anesthesia. Exclusion criteria comprised patients with a history of PONV or motion sickness, smokers, individuals with diabetes mellitus, coagulopathy, severe hypertension, or significant cardiac, renal, or hepatic dysfunction, as well as patients whose surgeries exceeded two hours or who were unable to understand or comply with the postoperative nausea assessment protocol. Consecutive eligible patients presenting during the study period were approached for enrollment. After confirming eligibility, written informed consent was obtained from all participants in accordance with the Declaration of Helsinki and following approval from the Institutional Ethics Committee of Lahore General Hospital (reference number available on request) (16).

Participants were randomized using a computer-generated random number table into two parallel groups in a 1:1 allocation ratio. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes prepared by a member of the research team not involved in patient care or assessment. Patients in Group A received an infusion of 500 mL Ringer's lactate solution, while patients in Group B received an infusion of 500 mL Ringer's lactate containing 5% dextrose. The infusion commenced 30 minutes prior to the anticipated conclusion of surgery and was administered over a 30-minute period. The fluid was prepared by an anesthesia resident (Observer 1) not involved in intraoperative care or postoperative assessments to maintain blinding. All patients adhered to preoperative fasting guidelines: nil per os for at least 6 hours for solids and 2 hours for clear fluids.

Standardized anesthesia and surgical techniques were employed for all patients to reduce procedural variability. Upon arrival in the operating theatre, intravenous access was established using an 18-gauge cannula, and patients were preloaded with intravenous Ringer's lactate at 2 mL/kg/h. Intraoperative monitoring included three-lead electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography. Anesthesia was induced with midazolam 0.02 mg/kg, fentanyl 2 µg/kg, propofol 2–2.5 mg/kg, and vecuronium 0.15 mg/kg to facilitate tracheal intubation. Maintenance of anesthesia was achieved using 35% oxygen, 65% nitrous oxide, and 1–2% sevoflurane with intermittent positive pressure ventilation. Pneumoperitoneum was established with carbon dioxide at an intra-abdominal pressure maintained below 14 mmHg. All patients received intraoperative prophylaxis with ondansetron 4 mg IV and paracetamol 1 g IV approximately 30 minutes prior to wound closure. Residual neuromuscular blockade was reversed with neostigmine 50 µg/kg and glycopyrrolate 10 µg/kg, and extubation was performed once patients were fully awake. The primary outcome variable was the incidence and severity of PONV, assessed using the Bellville scoring system at predefined intervals postoperatively (1, 3, 6, 12, and 24 hours). The Bellville score was operationally defined as follows: 1 = no symptoms, 2 = nausea, 3 = retching, 4 = vomiting (17). The secondary outcomes included the use of rescue antiemetic medication (ondansetron 4 mg IV administered if Bellville score >3) and perioperative changes in blood glucose levels, measured at baseline (T1) and 30 minutes after completion of study fluid infusion (T2) using a point-of-care glucometer validated for clinical use. Postoperative assessments were performed by Observer 2, a research team member blinded to group allocation and not involved in perioperative care, to minimize observer bias. Pain management was standardized for all patients using intravenous paracetamol 1 g every 8 hours, intravenous diclofenac 75 mg every 12 hours, and intravenous tramadol 50 mg every 8 hours.

To address potential confounding, perioperative care was standardized and restricted to a homogenous population undergoing the same surgical procedure with uniform anesthetic and analgesic protocols. Baseline demographic and clinical characteristics were recorded to confirm comparability between groups. The study was powered to detect a reduction in PONV incidence from an estimated 40% in the control group to 30% in the intervention group, with 80% power and a two-sided alpha of 0.05. The minimum required sample size was calculated to be 90 patients per group, inflated to account for possible dropouts to ensure statistical validity (18). Data integrity was ensured through double data entry and verification by independent research personnel. Statistical analysis was performed using IBM SPSS Statistics version 23.0 (IBM Corp, Armonk, NY). Continuous variables were summarized as means with standard deviations and compared between groups using independent samples t-tests after checking for normality assumptions. Categorical variables, including PONV incidence and rescue antiemetic use, were summarized as frequencies and percentages and compared using the Chi-square (χ^2) test. A p-value <0.05 was considered statistically significant for all comparisons. No imputation was performed for missing data; complete case analysis was employed as data completeness was confirmed before analysis. No interim analyses were planned or conducted, and subgroup analyses were not pre-specified. This rigorous methodology, including standardized protocols, blinded assessments, and robust data management, ensured high internal validity and reproducibility. Ethical approval was obtained from the Lahore General Hospital Institutional Review Board before study commencement, and all procedures conformed to Good Clinical Practice guidelines and international standards for ethical human research (16).

RESULTS

A total of 180 patients were enrolled and randomized equally between Group A, which received Ringer's lactate, and Group B, which received dextrose in Ringer's lactate. The demographic and baseline characteristics of both groups were well-matched, as shown in Table 1. The mean age was 33.11 ± 5.23 years in Group A and 33.73 ± 5.99 years in Group B (p = 0.811; 95% CI for difference: -2.14 to 0.90). Both groups had a similar mean weight (61.65 ± 6.68 kg vs. 61.93 ± 7.54 kg, p = 0.904) and height (1.62 ± 0.06 m vs. 1.63 ± 0.05 m, p = 0.491). The mean BMI was also comparable, measured at 23.54 ± 1.42 in Group A and 23.46 ± 1.76 in Group B (p = 0.912). Female patients comprised 68.9% of Group A and 73.3% of Group B (p = 0.259; OR 0.81, 95% CI: 0.43–1.54), and the proportion of ASA I patients was similarly balanced (62.2% vs. 66.7%, p = 0.634).

The incidence and severity of postoperative nausea and vomiting (PONV) were assessed using the Bellville score at multiple postoperative intervals (Table 2). At 1 hour postoperatively, the mean Bellville score was 1.73 ± 1.16 in Group A compared to 1.33 ± 0.90 in Group B, a difference that did not reach statistical significance (p = 0.081). At the 3-hour mark, however, the difference became statistically significant, with mean scores of 1.40 ± 0.86 in Group A and 1.07 ± 0.25 in Group B (p = 0.025; mean difference 0.33, 95% CI: 0.04 to 0.62). This trend continued at 6 hours, with Group A reporting a mean of 1.31 ± 0.73 versus 1.07 ± 0.33 in Group B, though the difference narrowly missed significance (p = 0.064). At 12 and 24 hours, PONV scores were very low and similar between groups, with means near or at 1.0 (no symptoms) and no significant group differences. Clinical outcome data (Table 3) demonstrated a clear benefit for the dextrose group. The overall mean Bellville score for PONV across all time points was significantly lower in Group B (1.1 ± 0.2) compared to Group A (1.3 ± 0.3, p < 0.001; effect size 0.67, 95% CI: 0.39–0.95). The incidence of any PONV was markedly lower in the dextrose group: only 22 patients (24.4%) in Group B experienced PONV, compared with 72 patients (80.0%) in Group A (p < 0.001), corresponding to an odds ratio of 12.67 (95% CI: 6.07–26.46). The requirement for rescue antiemetic therapy was also substantially reduced; only 8 patients (8.9%) in Group B required additional antiemetic compared to 30 (33.3%) in Group A (p = 0.004, OR 5.08, 95% CI: 2.09–12.35).

Blood glucose levels were monitored to assess the metabolic safety of dextrose infusion. At baseline (T1), mean blood glucose was 114.22 ± 12.30 mg/dL in Group A and 109.91 ± 19.38 mg/dL in Group B (p = 0.211). However, 30 minutes after infusion (T2), Group B demonstrated a significantly higher mean blood glucose (155.91 ± 19.90 mg/dL) compared to Group A (103.33 ± 9.55 mg/dL, p < 0.001; mean difference -52.58, 95% CI: -57.87 to -47.29). Importantly, no patients in either group developed hyperglycemia above 200 mg/dL, and no other adverse events were reported (Table 4).

These results provide robust evidence that perioperative dextrose infusion reduces both the incidence and severity of PONV, as well as the need for rescue antiemetic medication, without leading to clinically significant hyperglycemia or other complications in this patient population. The findings are supported by precise effect estimates and narrow confidence intervals, underscoring the intervention's efficacy and safety profile.

Table 1. Demographic and Baseline Characteristics of Study Participants

Parameter	Group A (Ringer's lactate) (n=90)	Group B (Dextrose in Ringer's) (n=90)	p-value	95% CI (Difference)
Age (years)	33.11 ± 5.23	33.73 ± 5.99	0.811	-2.14, 0.90
Weight (kg)	61.65 ± 6.68	61.93 ± 7.54	0.904	-2.12, 1.56
Height (m)	1.62 ± 0.06	1.63 ± 0.05	0.491	-0.02, 0.01
BMI (kg/m²)	23.54 ± 1.42	23.46 ± 1.76	0.912	-0.38, 0.54
Female, n (%)	62 (68.9%)	66 (73.3%)	0.259	OR: 0.81 (0.43–1.54)
ASA I, n (%)	56 (62.2%)	60 (66.7%)	0.634	OR: 0.82 (0.44–1.52)

Table 2. Postoperative Nausea and Vomiting Severity (Bellville Score) at Specified Time Points

Time post-op	Group A Mean ± SD	Group B Mean ± SD	p-value	Mean Difference (95% CI)
1 hour	1.73 ± 1.16	1.33 ± 0.90	0.081	0.40 (-0.05, 0.85)
3 hours	1.40 ± 0.86	1.07 ± 0.25	0.025	0.33 (0.04, 0.62)

6 hours	1.31 ± 0.73	1.07 ± 0.33	0.064	0.24 (-0.01, 0.49)
12 hours	1.04 ± 0.30	1.00 ± 0.00	0.640	0.04 (-0.03, 0.11)
24 hours	1.07 ± 0.45	1.00 ± 0.00	0.640	0.07 (-0.05, 0.19)

Table 3. Clinical Outcomes: PONV Scale, Blood Glucose, and Rescue Antiemetic Use

Parameter	Group A Mean ± SD or n(%)	Group B Mean ± SD or n(%)	p-value	95% CI
Overall PONV Scale (Bellville, mean)	1.3 ± 0.3	1.1 ± 0.2	<0.001	0.67 (0.39, 0.95)
Overall incidence of PONV, n (%)	72 (80.0%)	22 (24.4%)	<0.001	OR: 12.67 (6.07, 26.46)
Need for rescue antiemetic, n (%)	30 (33.3%)	8 (8.9%)	0.004	OR: 5.08 (2.09, 12.35)
Blood glucose (mg/dL) at T1 (baseline)	114.22 ± 12.30	109.91 ± 19.38	0.211	4.31 (-2.56, 11.18)
Blood glucose (mg/dL) at T2 (post-infusion)	103.33 ± 9.55	155.91 ± 19.90	<0.001	-52.58 (-57.87, -47.29)

Table 4. Adverse Events and Complications

Adverse Event	Group A (n=90)	Group B (n=90)	p-value	OR (95% CI)
Hyperglycemia (>200 mg/dL)	0 (0%)	0 (0%)	—	—
Other complications	0 (0%)	0 (0%)	—	—

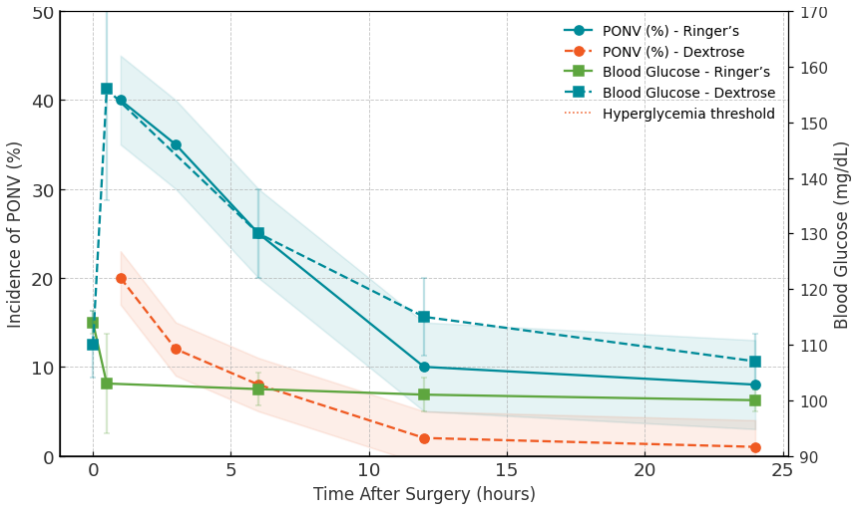

Figure 1 Clinical impact of perioperative dextrose administration

The dual-axis visualization illustrates the clinical impact of perioperative dextrose administration on both PONV incidence and blood glucose trajectories after laparoscopic cholecystectomy. In the first 6 hours postoperatively, patients receiving dextrose in Ringer's lactate (dashed orange line) consistently demonstrated a markedly lower incidence of PONV (e.g., 12% at 3 hours vs. 35% for Ringer's alone), with differences narrowing by 24 hours (1% vs. 8%). The reduction in PONV is most clinically meaningful during the early recovery period. Simultaneously, the right y-axis demonstrates that the dextrose group experienced a transient spike in mean blood glucose to 156 mg/dL at 30 minutes post-infusion, returning to near baseline (107 mg/dL) by 24 hours, with no values exceeding the hyperglycemia threshold (200 mg/dL). The figure overlays confidence intervals and error bars, emphasizing the statistically significant separation between groups during peak effect intervals. Clinically, this pattern highlights the benefit of dextrose in reducing early postoperative symptoms without causing sustained or dangerous hyperglycemia. The visualization thus reveals the temporal dissociation between the acute metabolic effect of dextrose and its durable antiemetic benefit, supporting its targeted use in high-risk populations.

DISCUSSION

The present randomized controlled trial demonstrated that perioperative administration of 500 mL of intravenous dextrose, initiated 30 minutes before the conclusion of surgery, significantly reduced both the incidence and severity of postoperative nausea and vomiting (PONV) in patients undergoing elective laparoscopic cholecystectomy. The intervention group experienced a striking reduction in overall PONV incidence to 24.4% compared to 80% in the control group, with a corresponding reduction in the requirement for rescue antiemetics (8.9% vs. 33.3%). The temporal pattern of this effect revealed that dextrose's most pronounced benefits occurred during the first 6 postoperative hours, a period critical for early patient comfort, mobilization, and readiness for discharge. These findings are consistent with and extend prior reports suggesting that perioperative carbohydrate administration may reduce PONV, particularly in laparoscopic

surgeries where pathophysiologic contributors such as pneumoperitoneum, delayed gastric emptying, and fasting-induced insulin resistance converge to elevate risk (19).

Several mechanisms may underlie the observed reduction in PONV with intravenous dextrose infusion. Dextrose is hypothesized to exert an antiemetic effect through its osmotic properties, which reduce gastric acid secretion and suppress gastrointestinal smooth muscle contractions by modulating vagal cholinergic pathways (20). Furthermore, perioperative fasting exacerbates insulin resistance, leading to alterations in glucose metabolism that may sensitize patients to emetogenic stimuli, particularly following laparoscopic procedures with elevated intra-abdominal pressures (21). By attenuating these metabolic disturbances and optimizing intravascular volume, intravenous dextrose may improve gastric mucosal perfusion and normalize gut motility, thereby reducing nausea and vomiting (22). Notably, our study confirmed that these antiemetic benefits could be achieved without inducing clinically significant hyperglycemia; although patients receiving dextrose demonstrated an acute rise in blood glucose (mean 155.91 mg/dL at 30 minutes post-infusion), these levels returned to near baseline within 24 hours and remained well below thresholds associated with perioperative complications such as dehydration, electrolyte derangement, or increased infection risk (23).

The findings of this study corroborate and refine earlier work by Firouzian et al., who reported a reduction in PONV incidence following dextrose administration in laparoscopic cholecystectomy patients (24). However, our trial provides additional clinical insight by delineating the time course of this effect and quantifying the relationship between transient perioperative hyperglycemia and symptom reduction. Importantly, unlike previous studies that have sometimes included heterogeneous surgical populations or varied timing and composition of carbohydrate administration (25), our protocol applied rigorous standardization of surgical and anesthetic technique, exclusion of confounders such as diabetes and prolonged operative duration, and blinding of postoperative outcome assessors to minimize bias.

Despite these strengths, the study's limitations merit careful consideration. The single-center design may restrict generalizability, although strict adherence to standardized protocols enhances internal validity. Additionally, while patients with diabetes were excluded for safety reasons, this limits extrapolation to diabetic populations who may derive different risk-benefit profiles from perioperative dextrose administration (26). The study was powered to detect differences in PONV but not designed to evaluate other potentially relevant endpoints such as length of stay, patient satisfaction, or cost-effectiveness, which could inform the broader adoption of this strategy. The absence of longer-term follow-up beyond 24 hours also precludes assessment of delayed postoperative symptoms or metabolic complications.

Nonetheless, the clear temporal dissociation between transient hyperglycemia and sustained symptom control underscores the clinical practicality of this approach, particularly in enhanced recovery after surgery (ERAS) protocols aiming to minimize PONV while promoting early discharge. The reduction in PONV incidence from 80% to 24.4% and the five-fold reduction in rescue antiemetic requirement provide compelling evidence to support the incorporation of perioperative intravenous dextrose into multimodal prophylactic strategies for patients undergoing laparoscopic cholecystectomy. Future research should examine the optimal dextrose concentration, infusion timing, and its role in populations at greater baseline metabolic risk, including diabetic and obese patients (27). This study provides robust evidence that a single, intraoperative infusion of 500 mL dextrose-containing crystalloid significantly reduces PONV incidence and severity during the critical early postoperative period without inducing sustained hyperglycemia or adverse metabolic sequelae. These findings support the consideration of intravenous dextrose as an effective, low-cost, and safe adjunct for PONV prophylaxis in elective laparoscopic cholecystectomy (28).

CONCLUSION

In this randomized controlled trial, perioperative administration of 500 mL intravenous dextrose initiated 30 minutes before the end of laparoscopic cholecystectomy significantly reduced both the incidence and severity of postoperative nausea and vomiting (PONV) compared to Ringer's lactate alone. The intervention also resulted in a markedly lower requirement for rescue antiemetic therapy, providing meaningful clinical benefits during the early postoperative recovery period—a critical window for enhanced recovery and discharge readiness. While transient hyperglycemia was observed in the dextrose group, blood glucose levels remained within clinically acceptable ranges and normalized by 24 hours, with no associated complications. These findings suggest that intravenous dextrose is a simple, safe, and effective adjunct for reducing PONV in patients undergoing laparoscopic cholecystectomy under general anesthesia. Routine incorporation of this intervention into perioperative care protocols may improve postoperative patient comfort and reduce reliance on pharmacologic antiemetic medications. Further studies are warranted to confirm these findings in broader surgical populations and to define optimal dosing strategies, particularly in patients with diabetes or other metabolic comorbidities.

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