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ROLE OF PRE-OPERATIVE CARBOHYDRATE LOADING IN TERMS OF INTRA-OPERATIVE BLOOD GLUCOSE LEVELS AND POST-OPERATIVE NAUSEA AND VOMITING RANDOMIZED CONTROL TRIALS

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Abstract

Background: *Prolonged preoperative fasting is traditionally practiced to minimize the risk of aspiration; however, it may increase surgical stress, insulin resistance, and postoperative discomfort. Recent evidence suggests that preoperative carbohydrate loading can improve metabolic stability and recovery outcomes.*

Objective: *This randomized controlled trial aimed to evaluate the effects of preoperative carbohydrate loading on intra-operative blood glucose levels and the incidence of postoperative nausea and vomiting (PONV) in non-diabetic patients undergoing elective surgery.*

Methods: *A double-blind, placebo-controlled trial was conducted over six months, enrolling 150 adult patients (ASA I–III) scheduled for elective surgery under general anesthesia. Participants were randomized into two groups: one received a 400 mL carbohydrate-rich drink containing 50 g of complex carbohydrates two hours before induction, while the control group received a placebo. Intra-operative blood glucose levels were measured at multiple time points, and PONV incidence and severity were assessed within 24 hours post-surgery. Statistical analysis was performed using repeated-measures ANOVA and chi-square tests.*

Results: *Baseline characteristics were comparable between groups. The carbohydrate group showed significantly higher and more stable intra-operative blood glucose levels than the placebo group ($p < 0.001$). The incidence of PONV was significantly lower in the carbohydrate group (18.7%) compared to the placebo group (41.3%) ($p = 0.003$), with fewer patients requiring rescue antiemetics (9.3% vs. 26.7%, $p = 0.006$). Mean post-anesthesia care unit (PACU) stay was also shorter in the carbohydrate group ($p = 0.012$). No major adverse events were reported.*

Conclusion: *Preoperative carbohydrate loading effectively stabilizes intra-operative blood glucose, reduces PONV incidence and severity, and shortens*

recovery duration without increasing adverse events. These findings support incorporating carbohydrate loading into Enhanced Recovery After Surgery (ERAS) protocols to optimize perioperative outcomes.

INTRODUCTION

Although recent guidelines have stated that it is appropriate to reduce the interval of clear fluid ingestion to 2h prior to surgery,[1] as a routine, most of the patients are kept fasting after midnight for both solids as well as clear fluids. By decreasing the duration of fasting period, there has also been a decrease in the risk of dehydration and hypoglycemia and thereby a decrease in the perioperative morbidity.[2] Shortening of preoperative fasting with a nonparticulate carbohydrate-rich beverage up to 2h preoperatively has shown to reduce insulin resistance and surgical stress and, additionally, improved the patient's well-being. [3]

The primary objective of the present study was to assess the effect of carbohydrate drink given to non-diabetic patients 2h before surgery on the intraoperative blood glucose levels as compared to those patients who did not receive it. Secondary objectives included assessment of the incidence and severity of postoperative nausea and vomiting (PONV) and to compare the duration of intensive care unit stay in patients who were given carbohydrate drink preoperatively in contrast to those who did not receive it.

Several preoperative prophylactic antiemetics have been used to reduce the incidence of PONV. However, the risk is not entirely eliminated. Therefore, multimodal regimens have been recommended, including other non-pharmacological modalities such as acupuncture stimulation, adequate fluid hydration, and carbohydrate loading to control PONV. [4,5] Preoperative carbohydrate supplementation decreases gastric acid secretion and improves gastric emptying. [6,7] Consequently, it might aid in decreasing the incidence of PONV.

The preoperative administration of carbohydrate loading as a part of ERAS protocols reduces insulin resistance and tissue glycosylation, improves postoperative glucose control, and enhances postoperative comfort [8]. Several randomized controlled trials (RCTs) and meta-analysis have shown that preoperative carbohydrate loading decreased postoperative insulin resistance and side effects compared with those consuming placebo/water or in a fasted state [9,10].

Methodology:

This randomized, double-blind, placebo-controlled clinical trial was conducted over a period of six months to evaluate the role of pre-operative carbohydrate loading on intra-operative blood glucose levels and post-operative nausea and vomiting (PONV). A total of 150 adult patients scheduled for elective surgeries under general anesthesia were enrolled. The study was carried out at the surgical and pre-operative units of a tertiary care hospital. Participants were aged between 18 and 65 years with an American Society of Anesthesiologists (ASA) physical status of I–III. Patients with diabetes mellitus, impaired glucose tolerance, pregnancy, emergency surgeries, severe hepatic or renal disease, or a body mass index (BMI) above 40 kg/m² were excluded from the study. Those with gastrointestinal disorders affecting gastric emptying or a history of PONV within 24 hours before surgery were also excluded.

The participants were randomly divided into two groups, each consisting of 75 patients. Randomization was achieved through a computer-generated sequence with allocation concealment using sealed opaque envelopes. The intervention group received a standardized carbohydrate-rich clear drink containing approximately 50 grams of complex carbohydrates in 400 mL, administered two hours before induction of anesthesia. The control group received a taste-matched placebo solution of similar volume that contained no carbohydrates. Both drinks were prepared and coded by pharmacy staff not involved in patient management or data collection to ensure blinding.

Blinding was maintained throughout the study for both patients and outcome assessors. Anesthetic management was standardized for all participants to minimize confounding variables. Induction agents, maintenance drugs, opioid dosing, neuromuscular blockade, and intra-operative fluids followed a

uniform institutional protocol. Prophylaxis for PONV was given according to hospital policy, and any variations were documented. Use of intra-operative glucose-altering agents such as steroids or dextrose-containing fluids was minimized and recorded when necessary.

The primary outcome of the study was intra-operative blood glucose levels measured at specific intervals—baseline (pre-drink fasting), immediately before induction, at 30 minutes, 60 minutes, and at the end of surgery. Secondary outcomes included the incidence and severity of PONV within 24 hours post-surgery, assessed at 2, 6, and 24 hours. The severity of nausea was evaluated using a visual analogue or 4-point nausea scale, and the number of vomiting episodes, need for rescue antiemetics, and duration of post-anesthesia care unit (PACU) stay were recorded. Blood glucose was measured using a calibrated point-of-care glucometer, and all data were collected on standardized case report forms.

Statistical analysis was performed on an intention-to-treat basis. Continuous variables such as glucose levels were analyzed using repeated-measures ANOVA or mixed-effects models, while categorical outcomes such as the incidence of PONV were compared using chi-square tests and logistic regression. A p-value less than 0.05 was considered statistically significant. In cases of missing data exceeding 5%, multiple imputation methods were applied, and sensitivity analyses were conducted to validate results.

All participants provided written informed consent before inclusion. The study protocol was approved by the Institutional Review Board and registered in a recognized clinical trial registry. Any adverse events such as aspiration, hyperglycemia, or allergic reactions were promptly reported to the ethics committee and managed according to institutional protocols. Data confidentiality was maintained by storing patient information in a secure electronic database accessible only to the research team. The overall duration of recruitment, intervention, and follow-up spanned six months, with periodic reviews to ensure adherence to study protocols and data accuracy.

Results:

A total of 150 patients were enrolled and randomized into the study. All 75 patients in the Carbohydrate Group and all 75 patients in the Placebo Group completed the trial protocol and were included in the final intention-to-treat analysis. The two groups were comparable at baseline with respect to demographic and clinical characteristics, as detailed in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants

Characteristic	Carbohydrate Group (n=75)	Placebo Group (n=75)	p-value
Age (years), Mean (SD)	48.5 (12.1)	47.8 (11.7)	0.72
Gender, n (%)			0.85
Male	40 (53.3%)	38 (50.7%)	
Female	35 (46.7%)	37 (49.3%)	
ASA Physical Status, n (%)			0.92
I	25 (33.3%)	26 (34.7%)	
II	38 (50.7%)	37 (49.3%)	
III	12 (16.0%)	12 (16.0%)	
BMI (kg/m²), Mean (SD)	26.4 (3.8)	26.1 (3.5)	0.61
Type of Surgery, n (%)			0.78
Abdominal	30 (40.0%)	32 (42.7%)	
Orthopedic	28 (37.3%)	25 (33.3%)	
Other	17 (22.7%)	18 (24.0%)	
Baseline Fasting Blood Glucose (mg/dL), Mean (SD)	92.3 (8.5)	93.1 (7.9)	0.55

Primary Outcome: Intra-operative Blood Glucose Levels

The changes in intra-operative blood glucose levels over time for both groups are presented in Table 2. At baseline, both groups had comparable fasting blood glucose levels (p=0.55). A significant interaction between group and time was observed ($p < 0.001$, repeated-measures ANOVA). The Carbohydrate Group exhibited a significant increase in blood glucose levels immediately before induction compared to the Placebo Group ($p < 0.001$). Throughout the surgery, the Carbohydrate Group maintained higher but stable glucose levels, whereas the Placebo Group showed a gradual decline. At all subsequent intra-operative time points, the difference in mean blood glucose levels between the two groups remained statistically significant ($p < 0.01$).

Table 2: Comparison of Intra-operative Blood Glucose Levels (mg/dL)

Time Point	Carbohydrate Group (n=75)	Placebo Group (n=75)	p-value
Baseline (Pre-drink Fasting)	92.3 (8.5)	93.1 (7.9)	0.55
Immediately Before Induction	118.6 (10.2)	94.8 (8.1)	<0.001
30 Minutes Intra-operative	115.4 (9.8)	92.1 (8.7)	<0.001
60 Minutes Intra-operative	112.7 (10.5)	90.3 (9.2)	<0.001
End of Surgery	109.8 (11.1)	89.5 (9.5)	<0.001
Data presented as Mean (Standard Deviation).			

Secondary Outcomes: Post-operative Nausea and Vomiting (PONV) and PACU Stay

The incidence and severity of PONV within the first 24 post-operative hours were significantly lower in the Carbohydrate Group compared to the Placebo Group (Table 3). Overall, 14 patients (18.7%) in the Carbohydrate Group experienced PONV, compared to 31 patients (41.3%) in the Placebo Group ($p = 0.003$). The need for rescue antiemetics was also significantly reduced in the intervention group (9.3% vs. 26.7%, $p = 0.006$).

Furthermore, the duration of stay in the Post-Anesthesia Care Unit (PACU) was significantly shorter for patients who received the carbohydrate drink, with a mean reduction of approximately 18 minutes ($p = 0.012$).

Table 3: Post-operative Nausea, Vomiting, and Recovery Parameters

Outcome	Carbohydrate Group (n=75)	Placebo Group (n=75)	p-value
Incidence of PONV (0-24h), n (%)	14 (18.7%)	31 (41.3%)	0.003
Severe Nausea (≥7/10 VAS), n (%)	5 (6.7%)	14 (18.7%)	0.03
Requirement for Rescue Antiemetic, n (%)	7 (9.3%)	20 (26.7%)	0.006
Duration of PACU Stay (minutes), Mean (SD)	105.2 (25.8)	123.1 (32.5)	0.012

Adverse Events

No major adverse events, such as pulmonary aspiration, clinically significant hyperglycemia requiring intervention, or allergic reactions to the study drink, were reported in either group during the study period.

Discussion:

This randomized controlled trial demonstrated that pre-operative carbohydrate loading contributes to more stable intra-operative blood glucose levels and a reduction in surgical stress response. Furthermore, it significantly decreased the incidence and severity of postoperative nausea and vomiting (PONV) while also shortening the recovery stay. Importantly, there was no observed increase in adverse events, indicating that this is a safe and effective

intervention that can be integrated into Enhanced Recovery After Surgery (ERAS) protocols to optimize patient outcomes.

Our findings are consistent with previous studies that reported similar outcomes. Both our study and earlier trials found that patients who received pre-operative carbohydrate loading exhibited higher intra-operative blood glucose levels but experienced significantly fewer postoperative nausea and vomiting episodes, along with a reduced need for rescue antiemetics compared to control or placebo groups [11]. Similarly, comparable studies demonstrated that carbohydrate loading before surgery led to lower rates of PONV, decreased antiemetic use, and higher patient satisfaction without any reported complications [12].

Additionally, our results align with meta-analyses assessing the effects of oral carbohydrate-rich beverages on PONV. These analyses have consistently shown a significant reduction in both the incidence of PONV and the requirement for rescue antiemetic medication among patients receiving preoperative carbohydrate drinks compared to those given a placebo [13]. Corresponding studies have also confirmed that baseline characteristics between groups were comparable, with intervention groups demonstrating improved postoperative outcomes, including reduced nausea, vomiting, and antiemetic use, further supporting our findings [14].

However, our results only partially correspond with one referenced study, which also observed significantly higher intra-operative blood glucose levels in the carbohydrate group than in the placebo group. While that study did not find a statistically significant difference in PONV incidence, our research demonstrated a notable reduction in postoperative nausea and vomiting following preoperative carbohydrate loading [15]. This suggests

that carbohydrate loading not only stabilizes intra-operative glucose but may also offer additional postoperative benefits under specific clinical conditions.

Conclusion

This randomized controlled trial demonstrates that pre-operative carbohydrate loading in non-diabetic patients is a safe and effective intervention. It results in more stable and higher intra-operative blood glucose levels and significantly reduces the incidence and severity of post-operative nausea and vomiting (PONV). Additionally, it shortens recovery time in the post-anesthesia care unit (PACU).The findings confirm that administering a carbohydrate-rich drink two hours before surgery aligns with Enhanced Recovery After Surgery (ERAS) protocols. It offers significant benefits by mitigating surgical stress, improving patient comfort, and enhancing recovery outcomes without increasing the risk of adverse events

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