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Effect of Preoperative Oral Carbohydrate Loading on Incidence and Severity of Postoperative Nausea and Vomiting following Elective Surgeries under General Anaesthesia: A Randomised Controlled Study

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Conflict of interest: Nil

Abstract

Background & Aims: Postoperative nausea and vomiting (PONV) is a frequent complication in immediate postoperative period following general anaesthesia (GA), particularly in day care anaesthesia where patients have to discharge on the same day of surgery. Preventing PONV in this setting is crucial because PONV can delay recovery, extend the time to discharge, or even lead to unplanned hospital admissions. Hence, present research was conducted to study the effect of preoperative oral carbohydrate loading on incidence of PONV compared to plain water following elective surgery under GA as primary objective. Secondary objectives were PONV severity, peri-operative blood sugar levels, gastric volume 2 hours after oral intake of study solution, number of surgeries postponed due to high gastric volume, patient discomfort and complications within 24 hours post-surgery.

Material & Methods: This prospective randomized study was done in 200 patients undergoing elective surgeries under GA after Institutional Scientific and Ethical Committee approval. Group A received 200 ml of a 50% dextrose solution (50 ml dextrose in 150 ml water) while Group B received 200 ml of water orally, 2 hours before surgery. Gastric ultrasound was performed at four time points (T0-T3), and RBS levels were recorded at four intervals (R0-R3). PONV was assessed using the PONV Impact Scale Score, and VAS scores for thirst, hunger, anxiety, mouth dryness, nausea, weakness, and sleep quality were recorded for 24 hours postoperatively.

Results: PONV incidence was significantly higher in Group B (28.9%) compared to Group A (14.4%) (p=0.019). Group A had more patients in Grade 0 PONV

(85.6% vs. 71.1%, p=0.019). Although nausea grades 1-3 showed no significant differences, Group B had more severe vomiting (13.3% Grade 2, and 8.9% Grade 3) ($p < 0.001$). RBS levels differed significantly at R2 (p=0.001), while GV levels were similar across time points, without any delays in surgery or complications. Thirst and hunger were higher in Group B (p=0.001), but other symptoms were comparable between groups.

Conclusion: Oral administration of carbohydrate-rich liquid two hours before surgery reduces incidence and severity of PONV, decreases thirst and hunger, has no complications, and does not affect gastric emptying, making it a safe alternative to plain water.

Keywords: Day care surgery, PONV, Carbohydrate containing liquid, Gastric Volume

Introduction

Postoperative nausea and vomiting (PONV) is a common concern in immediate postoperative period, particularly in day care anaesthesia where patients are discharged on the same day of surgery.[1] Managing PONV in this setting is essential because PONV can lead to delayed hospital discharge, wound dehiscence, pulmonary aspiration and dehydration. The incidence of PONV ranges between 20-40% despite antiemetic measures.[2,3,4] The American Society of Anesthesiologists (ASA) recommends that clear liquids may be ingested for up to 2 h before surgical procedure requiring anesthesia.[5] Shortened preoperative fasting combined with ingestion of a carbohydrate rich beverage 2 hours prior to surgery reduces stress thus enhancing patient comfort.[6] The primary objective of our study was to evaluate the incidence of PONV after oral carbohydrate loading 2 hours prior in patients undergoing elective surgery under general anaesthesia. Secondary objectives were to assess severity of PONV, gastric volume 2 hours after intake of study solution, peri operative RBS, no. of surgeries postponed due to high gastric volume, patient discomfort and complications up to 24 hours post operatively.

Material & Methods

This prospective, randomized, interventional study was conducted at Pt. J.N.M. Medical College & Dr. B.R.A.M. Hospital, Raipur, C.G. after institutional scientific & ethical committee approval. Inclusion criteria were patients aged 18-60 years, ASA grade I and II, body mass index (BMI) of 18 to 29.9 kg/m^2 and intake of solid food > 6 hrs. back. Exclusion criteria were patient refusal, surgery lasting > 2 hrs, pregnancy, known case of diabetes mellitus, hiatus hernia, history of gastrointestinal surgeries and use of any medication (metoclopramide, cisapride, domperidone, antihistamines, atropine etc.) that effects gastric secretion or emptying within the past 24 hours.

Based on study conducted by Sunil Rajan et al (2021) $z1-\alpha/2= 1.96$ at 95% confidence interval and margin of error= 10%, a sample size of 200 was calculated to obtain statistically significant results [Table 1].[7]

After obtaining a written informed consent enrolled patients were randomized into two groups A and B by sequentially numbered opaque sealed envelope (SNOSE) technique. Oral solution was prepared by trained personnel with code and was administered as per the allocated group. Patients in Group A received 50 ml of 50% dextrose in 150 ml of water (200ml) and in Group B received 200 ml plain water two hours before scheduled surgery. The patient and observer both were blinded to group assignments. Baseline fasting RBS and gastric volume was measured in both groups before administration of study oral solution (T0).

Thereafter, Gastric ultrasound was repeated at T1 (5 min after intake), T2 (1 hr after intake), and T3 (2 hr after

intake). For that, patient was placed in right lateral decubitus (RLD) position and low-frequency curvilinear transducer (2–5 Hz) was placed in the sagittal or sagittal oblique plane in the epigastrium to obtain a cross-sectional image of the gastric antrum. Along the edge of the left lobe of the liver, and anterior to either the aorta or the inferior vena cava, according to the standard protocol. Then, measured antero-posterior (AP) and cranio-caudal (CC) diameter of the gastric antrum. The cross-sectional area (CSA) of the gastric antrum was quantified using the following formula: CSA=π×AP×CC/4 Through this antral CSA, gastric volume (GV) was estimated by a previously validated formula : GV (ml)=27.0+14.6×right-lat CSA (cm2)–1.28×age (yr.), where right Lat CSA denotes antral CSA, as measured in the RLD position.[8] Surgery was postponed, when GV was >1.5 mL/kg at T3, considering risk of aspiration.[8]

General anaesthesia was administered as per institutional protocol. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), SpO2 and respiratory rate (RR) were recorded intraoperative every 15 min till the end of surgery. After extubation, patients were shifted to high dependency unit for further observation. RBS value was recorded 1 hour following induction (R2) and immediately post extubation (R3).

Post Operative Nausea and Vomiting was assessed using Post Operative Nausea and Vomiting Impact Scale Score (PONV ISS).[9] PONV, if experienced was managed with intravenous antiemetics, ondansetron 0.1 mg/kg, followed by metoclopramide 10 mg and dexamethasone 0.1mg/kg in that order. Visual analogue scale (VAS) scores for seven parameters (thirst, hunger, anxiety, mouth dryness, nausea, weakness and sleep quality) were recorded and compared for 24 hours postoperatively. Pearson's chi-square test was used to measure statistical difference for qualitative data such as gender, ASA status, patient discomfort and complications. T-test was used to compare the mean values of quantitative data such as age, BMI, incidence of PONV, severity of PONV, gastric volume, perioperative RBS and no. of surgeries postponed. Statistical analyses were done using SPSS version 20.0 for windows.

Results

The data of 180 patients were analysed statistically [Figure 1]. Age, height, weight, BMI, distribution of gender and ASA status were comparable in both groups [Table 1].

The incidence of PONV was significantly high in Group B; as 26 (28.9%) vs 13 (14.4%); p=0.019 [Table1].

Though, the distribution of patients among various nausea grade was non-significant between the groups, but significantly higher number of patients in group B had Grade 2 and 3 vomiting, i.e. 12 (13.3%) and 8 (8.9%) compared to none in Group A (p <0.001) [Table 2].

There was no significant difference in RBS levels at various time points within the group from baseline RBS (p>0.05). On intergroup comparison significant difference was observed only at R2 (p= 0.001) [Table 3].

There was a dramatic increase in CSA of gastric antrum at T1 in both groups, which remained high even at T2 as compared to T0. At T3, CSA returned to baseline levels in both the groups. The gastric volume was higher in group A at every point of time compared to Group B; but it was statistically non-significant. As, in both the groups GV was below 1.5ml/kg at T3 therefore not a single surgery was postponed in either of the groups [Table 4].

Group B reported significantly higher levels of thirst and hunger compared to Group A (p = 0.001). The mean VAS for rest of the parameters like anxiety, mouth dryness,

nausea, weakness, and sleep quality was comparable between the groups. No complications were reported in patients of either group.

Discussion

We observed significantly lower incidence and severity of PONV along with lower level of thirst and hunger in patients who received oral carbohydrate loading 2 hours before elective surgery under GA. Gastric volume raised initially but came to baseline after 2h in both the groups. None of the cases was postponed because of high gastric volume. RBS at various time period was comparable to baseline in both the groups but it was significantly low in group A at R2, i.e. 1h after induction.

India with only 6% of global hospital beds and 20% of the disease burden, has a strong reason for expanding day-care surgery, which can cut treatment costs by 70% and support faster, more affordable patient care.[1] PONV is the most commonly reported complication after anaesthesia and leads to prolonged stay in post anaesthesia care unit and thus shattering the main aim of day care surgery.[4] Overnight fasting on the day of surgery is the standard practice in most hospitals. Patients who fast overnight before surgery may experience negative metabolic, physiological and/or psychological effects. The American Society of Anesthesiologists (ASA) recommends that patient without delayed gastric emptying should refrain from ingesting transparent liquids for at least 2 hours before elective procedures.[5]

Day care surgery requires different anaesthesia approaches than inpatient surgery, and adopting ERAS principles can help minimize complications and accelerate recovery. Carbohydrate loading is one of the preoperative component of ERAS in which patients enter surgery in a fed state rather than a fasted state. Carbohydrate loading reduces insulin resistance, which helps decrease hospital stays, postoperative complications, muscle breakdown, and improves hemodynamic stability during surgery.[11-14]

Anaesthesia disrupts glucose regulation in fasting patients, leading to increased blood glucose through cortisol-induced gluconeogenesis, protein breakdown, and catecholamine-triggered insulin inhibition, along with heightened free fatty acid levels.[15]

We observed significantly lower incidence and severity of PONV in patients who received oral carbohydrate loading 2 hours before elective surgery under general anaesthesia. This could have been due to reduced insulin resistance, stabilised blood glucose levels, normalisation of digestive tract function and alleviation of psychological & metabolic stress.[16] It had gastric emptying time similar to plain water thus minimising residual gastric content and lowering the risk of nausea and vomiting related to slow gastric emptying. Previous research had shown that preoperative carbohydrate loading had reduced both PONV and antiemetic consumption. [7,17,18] As nausea alone, without vomiting is substantially disturbing sensation experienced in the post operative period, we separately recorded grading of nausea and vomiting, although such observations were not found in any literature as per our search results. Group A had a smaller percentage of patients experiencing post-operative nausea than Group B, but there was no statistically significant difference in the distribution of nausea Grades 1, 2, and 3. Along with a decrease in vomiting incidence in Group A, no patients suffered vomiting grade 2 or 3. Lauwick S. et al (2009) found that severity of PONV were alike in both groups because they used different volume of study solution and used synthetic opioid upon arrival of patients in the PACU.[19] Higher grades of PONV are associated with

lower patient satisfaction due to discomfort and potential complications. Effective management of PONV can lead to better overall postoperative outcomes and lower morbidity rates. Understanding PONV grades helps in tailoring pre-emptive and reactive treatments to minimize the impact of PONV on patients. Healthcare providers can better allocate resources and plan for potential interventions based on the expected severity of PONV. By aiming to reduce the incidence of higher PONV grades through preventive measures and effective management strategies, healthcare providers can improve patient outcomes and optimize the use of healthcare resources. Maintaining normoglycemia reduces metabolic stress, preventing further physiological complications and aiding in overall recovery. Hyperglycaemia can alter the pharmacokinetics and pharmacodynamics of anaesthetic agents, potentially leading to unpredictable responses. Normoglycemia ensures more predictable and safer anaesthesia management. There was a significant difference in RBS levels between the two groups at R2 which was similar to the study conducted by Rajan S et al.[7] The low RBS at R2 may result from enhanced insulin release and sensitivity following carbohydrate loading, which offsets stress hormone effects. Patients receiving carbohydrates had lower intraoperative glucose levels due to reduced insulin resistance and counter regulatory hormonal actions.

Our findings were similar to the study conducted by Zhang Z. et al (2020) in which they found that upon oral intake of water or a carbohydrate-rich liquid, there was a significant surge in cross-sectional area (CSA) observed at T1 for both experimental groups.[20] This heightened CSA persisted at T2 compared to the baseline measurement (T0) for both groups before returning to baseline levels by T3. Perlas A. et al (2016) in their study reported that if GV exceeds 1.5 mL/kg at the time of anaesthesia induction, there is a risk of aspiration. Hence, we decided to delay the surgery in case gastric volume on USG was higher than 1.5 mL/kg.[8] In our study both carbohydrate drink and plain water had similar gastric emptying time, moreover none of the patient in our study had GV >1.5 ml/kg due to which no case was postponed. No event of any complications like aspiration, allergic reactions, bloating and diarrhoea were noted in our study.

Our study measured discomfort using the VAS scale across seven parameters (thirst, hunger, anxiety, mouth dryness, nausea, weakness and sleep quality) and found that Group B reported significantly greater thirst and hunger than Group A. No differences were observed between groups for anxiety, mouth dryness, nausea, weakness, or sleep quality, which is similar with the results of study conducted by Wang Y. et al (2019).[21] Most of the reviewed literature evaluated the effects of carbohydrate loading on patient discomfort preoperatively.–Limitation of our study was that exact fasting time could not be recorded. Type of meal taken was not taken in to consideration. Waiting time from arrival at pre-operative area to induction of anaesthesia could not be standardised.

The study can be extended to different surgical populations, such as those undergoing gastrointestinal surgeries, where patients often require bowel preparation that can lead to increased hypoglycaemia and dehydration. The scope of study can be extended to diabetic, geriatric and sick patients in which a simple intervention can help us to combat the catabolic effects, accelerate post-operative recovery, thereby reducing hospital stay and improving patient comfort.

Conclusion

This study concludes that administering a carbohydrate-rich liquid orally to patients two hours before surgery reduces the incidence and severity of postoperative nausea and vomiting. Additionally, it does not increase gastric volume before induction or pose a risk of delaying surgery. There are no associated complications such as aspiration, flatulence, or bloating. Therefore, oral carbohydrate-rich liquid can be safely given two hours before surgery.

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Legend Figure and Tables

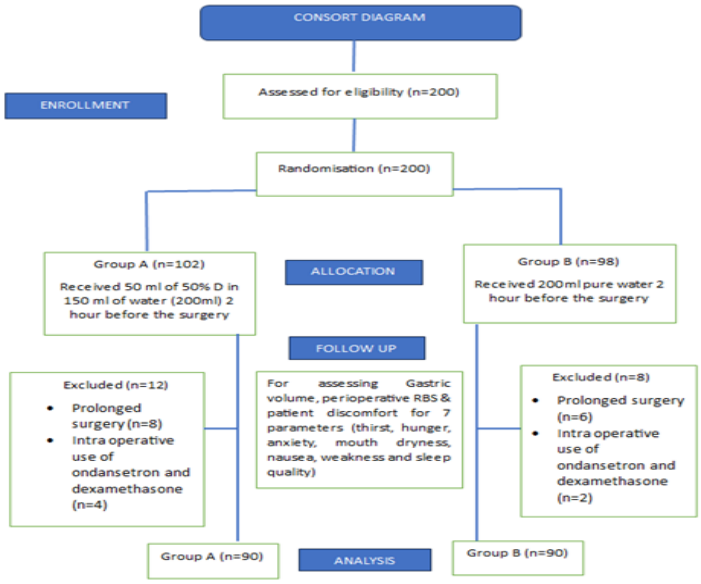

Figure 1: Consort Flow Diagram

Table 1: Demographic Profile and incidence of PONV

	Group A	Group B	P value
Age (Mean±SD) in years	38.80±8.28	38.34±6.76	0.686

Weight (Mean±SD) in kgs	61.96±9.60	63.84±10.32	0.192
Height (Mean±SD) in cm	165.11±6.86	165.089±6.84	0.983
BMI (Mean±SD) in kg/cm^2	22.70±3.26	23.37±3.16	0.161
M: F [n (%)]	63 (70): 27 (30)	58(64.4):32 (35.6)	0.427
PONV [n (%)]	13 (14.4)	26 (28.9)	0.019

Table 2: Patient's distribution according to grade of nausea and vomiting

	Nausea			Vomiting		
	Group A n (%)	Group B n (%)	p value	Group A n (%)	Group B n (%)	p value
Grade 0	77 (85.6)	64 (71.1)	0.019	77 (85.6)	64 (71.1)	0.019
Grade 1	3 (3.33)	4 (4.44)	1.00	13 (14.4)	6 (6.7)	0.090
Grade 2	4 (4.44)	12 (13.33)	0.162	0 (0)	12 (13.3)	0.0001
Grade 3	6 (6.66)	10 (11.11)	0.213	0 (0)	8 (8.9)	0.004

Table 3: Mean Perioperative RBS at various observation time

Variables	Group A		Group B		p value Group A vs Group B
	Mean±SD (mg/dl)	p value	Mean±SD (mg/dl)	p value	
R0- Fasting RBS before assigned drink	104.27±14.89	NA	107.034±11.66	NA	0.112
R1- Just before induction of Anaesthesia	100.59±8.83	0.104	101.39±12.67	0.124	0.165
R2 - 1 hour following induction	94.65±10.43	0.100	106.16±16.61	0.156	0.001
R3- Immediate post extubation	104.77±12.23	0.130	109.66±10.91	0.178	0.123

Table 4: USG parameters of gastric antrum at various time points

Time point			T0	T1	T2	T3
Group A	Mean±SD	A.P. (cm)	2.71±1.23	5.04±2.53	3.33±1.41	2.53±1.19
		C.C. (cm)	2.36±0.67	5.02±1.23	3.05±3.62	2.64±0.64
		CSA (cm^2)	4.47±0.55	9.59±1.39	6.23±0.92	4.56±0.78
		Gastric volume (ml)	41.77±11.73	124.51±71.57	67.96±17.46	42.83±14.47
Group B	Mean±SD	A.P. (cm)	1.99±0.69	3.47±1.09	2.21±0.96	2.16±1.20
		C.C. (cm)	2.77±0.77	3.28±0.74	3.35±1.02	3.04±1.14
		CSA (cm^2)	4.08±0.48	8.63±1.51	5.39±2.25	4.22±0.41
		Gastric volume (ml)	39.41±9.02	110.77±21.37	64.77±16.31	39.33±11.66
P Value	Gr A vs Gr B	Gastric volume	0.131	0.083	0.201	0.076