Original Article

Comparison of Preoperative Oral Carbohydrate Fluid and Intravenous Crystalloid for Prophylaxis of Postoperative Nausea and Vomiting in Gynaecological Laparoscopic Surgery

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Abstract

Background: Incidence of postoperative nausea and vomiting (PONV) is 20-50% in patients undergoing laparoscopic surgeries, which necessitates prophylaxis. This research aimed to assess the efficacy of a preliminary oral carbohydrate solution compared with intravenous crystalloid fluid for the prevention of postoperative nausea and vomiting (PONV) in patients undergoing gynecological laparoscopic surgery. **Material and Methods:** Fifty patients aged 18-50 years, ASA I, scheduled for gynaecological laparoscopic surgery, were randomly allocated to two groups. Patients received either 400 ml of oral carbohydrate (CHO group, n=25) or 10 ml/kg of Ringer's lactate I.V. (RL group, n=25) 2 hours before induction of anaesthesia. Postoperatively, patients were observed for PONV, pain, and other symptoms for 24 hours. The unpaired t-test, chi-square test, and ANOVA were used for statistical analysis. A p-value of less than 0.05 was deemed significant. **Results:** The total incidence of PONV in the CHO group and the RL group was 32% and 52% for 0-2 hours, and 40% and 52% for 0-24 hours, respectively. There was no significant difference in the requirement for rescue antiemetics to treat PONV among the groups. Blood glucose increased significantly at 60 minutes intraoperatively and 6 hours postoperatively relative to the preoperative baseline in each group, but there was no significant intergroup difference. Ketone bodies were detected at significantly higher levels in the urine of the RL group at 12 and 24 hours postoperatively. When comparing patient satisfaction parameters, patients in the CHO group were more satisfied than those in the RL group. **Conclusion:** Preoperative administration of 12% oral carbohydrate fluid was effective in controlling vomiting in the early postoperative phase, resulting in better overall patient satisfaction.

Keywords: Postoperative Nausea and Vomiting (PONV), Gynaecological laparoscopic Surgery, Oral carbohydrate fluid.

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Introduction

Post-operative nausea and vomiting (PONV) are among the most prevalent and unpleasant symptoms following anaesthesia and surgery. It is described as any bout of nausea, vomiting, or retching that occurs during the first twenty-four hours after surgery. PONV leads to anxiety, dehydration, metabolic and electrolyte imbalance, and wound disruption. It may delay discharge from the postoperative area or lead to prolonged hospital stay after day care procedures such as laparoscopic surgery.[1] Patients who are considered at high risk of PONV include female sex, history of PONV or motion sickness, and non-smokers. Pathophysiology of PONV has been linked to hypoperfusion of the gastric mucosa in fasting patients, which leads to excessive release of serotonin.[2] Preoperative use of fluid given orally or intravenously may prevent PONV by reducing gut ischemia.[3] Several different drugs and techniques have been used in the past for prophylaxis of PONV. The use of pharmacological agents is associated with various adverse effects and increases healthcare costs.[4]

Recently, the concept of ERAS has emerged, in which loading the patient with an oral carbohydrate solution at least 2 hours before surgery has improved postoperative outcomes by modifying insulin resistance, improving comfort, and decreasing the incidence of PONV.[5] The recent guidelines regarding the preoperative fasting suggest that clear fluid, maltodextrin-based carbohydrate fluid can be taken by a patient up to 2 hours before the surgery safely without any complications.[6,7] Drinks high in carbohydrates don't change the acidity of the stomach or shorten

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its emptying duration.[8]

Female gender, young age, head down position, and high intra-abdominal pressure combined with surgical procedures like laparoscopic surgery increase the risk of PONV fourfold from the general incidence of 20-30% 9 to about 54-82%.[9,10] As far as we are aware, no research has compared intravenous and oral carbohydrate fluids for the prevention of PONV. To prevent PONV in patients undergoing gynecological laparoscopic surgery under general anesthesia (GA), we conducted a randomised controlled trial comparing intravenous crystalloid fluid with preoperative oral carbohydrate fluid.

Materials and Methods

The current single-blind randomised controlled study was conducted in the Department of Anaesthesiology and Critical Care at University College of Medical Sciences and Guru Teg Bahadur Hospital, Delhi, from November 2014 to April 2016, following approval from the Institutional Ethical Committee and written informed consent from patients. Fifty female patients, aged 18 to 50, belonging to the American Society of Anaesthesiologists (ASA) grade I, undergoing elective gynaecological laparoscopic surgery under general anaesthesia, were selected and randomly allocated by using computer-generated randomisation charts to one of the two groups - Group CHO and Group RL. Patients of Group CHO received 400 ml of carbohydrate fluid (apple juice) orally 2-3 hours before induction of anaesthesia, while patients of Group RL received Ringer's Lactate 10 ml/kg of body weight. (500-700 ml) intravenously over a period of 2 hours before induction of anaesthesia. The healthcare worker who observed the patient for PONV was blinded to the study. Lactating or menstruating females, pregnant or obese women, a history of motion sickness, gastro-oesophageal reflux disease, esophagitis, hyperacidity, nausea and vomiting in previous surgery, a history of endocrine diseases, and patients on drugs like corticosteroids, β-blockers, β-agonists, anti-emetics, and opioids were excluded from the study.

The Visual Analogue Scale (VAS), which ranges from 0 to 100 (0 = no pain, 100 = the greatest possible agony), was taught to the patients in the preoperative room. Before induction and 24 hours after surgery, a questionnaire was used to measure patient satisfaction parameters such as thirst, hunger, dry mouth, weakness, fatigue, giddiness, and restlessness. Before the induction of anaesthesia, a blood sample was taken to estimate blood sugar, and a urine sample was taken to detect ketone bodies. Baseline vital signs were taken in the operating room, and routine monitoring was initiated, including a continuous electrocardiogram (ECG), heart rate (HR), non-invasive blood pressure (NIBP), and pulse oximetry (SpO2). Both during and after the procedure, hemodynamic parameters were monitored. Every patient received general anesthesia using the standard anesthetic approach. Injectable morphine (0.1 mg/kg) was used to give premedication and to aid in oro-tracheal intubation, vecuronium 0.1 mg/kg after thio-pentone (2.5%) 4-6 mg/kg was given to produce anaesthesia.

Anaesthesia was maintained with oxygen, nitrous oxide (1:2), sevoflurane (2-4%), and top-up doses of vecuronium as required, under train-of-four (TOF) monitoring, with intermittent positive-pressure ventilation (IPPV) and a target EtCO2 of 30-35 mmHg. A carbon dioxide pneumoperitoneum was created, and intra-abdominal pressure was monitored and remained consistently close to 12 mm Hg throughout the procedure. Adequate fluid therapy by I.V. infusion of Ringer's lactate was given. Blood sugar was measured intraoperatively at 60-minute intervals. Neostigmine (0.05 mg/kg) and glycopyrrolate (0.006 mg/kg) were used to reverse neuromuscular blockade after surgery, and the patient's trachea was extubated after sufficient recovery. No intraoperative antiemetic was administered to none of the patients in any group.

In the postoperative period, all patients were monitored for recording various parameters and managed accordingly. Postoperative nausea, retching, and vomiting were recorded as per the score given below at every hour for the first 6 hours and then at 12 hours and 24 hours.

0-no emetic symptoms,
1-nausea,
2-retching
3-vomiting
4-nausea and vomiting both.

If any patient had a symptom of PONV of any grade, they were treated with an injection. ondansetron 4 mg I.V., and the time was recorded. The total ondansetron requirement over 24 hours was recorded and compared between the groups. Analysis for these symptoms was done within the first 2 hours, 2-6 hours, 6-12 hours, 12-24 hours, and 0-24 hours. Blood sugar was measured at 6, 12, and 24 hours postoperatively in all patients. Urinary analysis for ketone bodies was performed at 6, 12, and 24 hours postoperatively. To assess patients' discomfort and comfort, all patients were asked about symptoms such as thirst, hunger, dry mouth, weakness, fatigue, excitement, and restlessness before and 24 hours after surgery.The main outcome metric was the occurrence of vomiting and nausea following surgery in the two groups.; secondary outcome measures included the need for antiemetic medication in two groups, changes in blood sugar and urinary ketone bodies, and pre- and postoperative patient satisfaction and discomfort.

Considering the proportion of 8.6% of patients (I.V. fluid) having episodes of post-operative nausea and vomiting, and 1.8 % in patients (oral carbohydrate fluid), to estimate an absolute difference of 15 - 20% at α=5%and power=80%, a sample of 25 cases was required in each group.[11-12] The Statistical Package for SPSS version 20.0 was used to conduct the statistical analysis. The quantitative parameters were compared using the unpaired t-test, and the qualitative parameters using the chi-square test. Haemodynamic parameters were compared using a repeated-measures ANOVA followed by Tukey's test at the 50% level of significance. A p-value of <0.05 was considered significant.

Results

Both groups were similar in age and body weight. (Table 1). The Mean duration of surgery in the Group CHO was 64.80 ± 10.36 min, and in the RL group it was 78.20 ± 18.9 min. The disparity in average operative period between the two sets was 13.40

minutes, which was statistically significant. Intravenous fluid requirements during surgery were comparable between the two groups, as shown in [Table 1].

Among the groups, the frequency of PONV was higher during the first 2 hours of the postoperative period than at other time intervals. Vomiting occurred in 4% and 28% patients in the CHO group and the RL group, respectively, with a statistically significant difference (p value<0.05) in the first 2 hours. The total incidence of PONV in the CHO group and the RL group was 32% and 52% for 0-2 hours, and 40% and 52% for 0-24 hours, respectively, with no statistically significant difference in PONV over the 24-hour postoperative period between the groups. [Table 2] shows the numbers and percentages of patients with nausea, retching, and vomiting in both groups at different time points. Also, the need for an emergency antiemetic to treat PONV did not differ significantly across groups.

Blood glucose significantly increased at 60 minutes intraoperatively and 6 hours postoperatively relative to the preoperative baseline value for each group, but there was no significant intergroup difference [Table 3].

None of the patients in both groups showed the presence of ketone bodies in their urine during the pre-induction period. At 6 hours post-operatively, no patients in the CHO group and 4 patients (16%) in the RL group had ketone bodies in their urine, with no statistically significant difference (p value >0.05). After 12 hours post-operatively, 12% of patients in the CHO group and 36% of patients in the RL group showed ketone bodies in their urine, with a statistically significant difference (p-value <0.05). At 24 hours post-operatively, 40% of patients in the CHO group were positive for ketone bodies, and 72% of patients in the RL group showed ketone bodies in their urine, with a statistically significant difference (p value <0.05). The differences in thirst, hunger, and dry mouth between the two groups were not substantial during the postoperative phase, although they were during the preoperative phase. There was no significant difference in the proportion of patients complaining of weakness at any time point between the two groups. The difference in tiredness was not significant pre-operatively, but became significant at 24 hours post-operatively, with greater tiredness in the CHO group. No patients in any group complained of giddiness at any moment. There was no discernible change. in restlessness between the groups both pre-operatively and post-operatively (p>0.005).

Table 1: Demographic Profile and Perioperative Characteristics of Study Groups

Variable	Group CHO (n = 25)	Group RL (n = 25)	p-value
Age (years)	29.36 ± 6.26	29.44 ± 6.42	0.96 (NS)
Body weight (kg)	54.20 ± 9.97	54.92 ± 7.48	0.14 (NS)
Total duration of surgery (min)	64.80 ± 10.36	78.20 ± 18.98	0.004 (S)
Total intraoperative IV fluids (mL)	1072.00 ± 179.17	1096.00 ± 283.55	0.722 (NS)

Data expressed as Mean ± SD. NS = Not significant; S = Significant.

Table 2: Incidence of Postoperative Nausea and Vomiting (PONV) and Antiemetic Requirement

A. PONV Incidence at Different Time Intervals

Time Interval	Symptom	Group CHO (n = 25)	Group RL (n = 25)	p-value
0–2 hours	Nausea	1 (4%)	1 (4%)	1.00
	Retching	2 (8%)	3 (12%)	1.00
	Vomiting	1 (4%)	7 (28%)	0.049*
	Nausea + Vomiting	4 (16%)	2 (8%)	0.667
	Total PONV	8 (32%)	13 (52%)	0.152
2–6 hours	Nausea	0	0	–
	Retching	1 (4%)	1 (4%)	1.00
	Vomiting	1 (4%)	0	1.00
	Nausea + Vomiting	1 (4%)	0	0.609
	Total PONV	3 (12%)	1 (4%)	0.609
6–12 hours	All symptoms	0	0	–
12–24 hours	All symptoms	0	0	–

* Statistically significant (p < 0.05)

B. Cumulative PONV Incidence (0–24 Hours)

Symptom	Group CHO (n = 25)	Group RL (n = 25)	p-value
Nausea	1 (4%)	1 (4%)	1.00
Retching	2 (8%)	3 (12%)	1.00
Vomiting	2 (8%)	7 (28%)	0.138
Nausea + Vomiting	5 (20%)	2 (8%)	0.417
Total PONV	10 (40%)	13 (52%)	0.395

C. Rescue Antiemetic Requirement

Variable	Group CHO	Group RL	p-value
Patients requiring rescue antiemetic (n)	10	13	0.395 (NS)
Total number of rescue doses	12	14	0.571 (NS)

Table 3. Perioperative Blood Glucose Levels (mg/dL)

Time Interval	Group CHO (n = 25)	Group RL (n = 25)	p-value
Pre-induction	98.04 ± 12.56	93.40 ± 12.23	0.750 (NS)
Intraoperative (60 min)	119.00 ± 18.26*	122.20 ± 13.76*	–
6 hours post-op	108.12 ± 14.14*	109.40 ± 12.59*	–
12 hours post-op	100.96 ± 6.45	99.64 ± 10.72	–

24 hours post-op	97.16 ± 8.16	94.68 ± 12.01	–

* Significant increase compared to pre-induction values (within-group analysis).
Data expressed as Mean ± SD.

Discussion

Gynaecological laparoscopic surgeries have been proven to be frequently associated with postoperative nausea and vomiting. Various pharmacological and non-pharmacological approaches to PONV therapy and prevention have been investigated. These days, antihistamines, metoclopramide, droperidol, and dexamethasone are employed in multimodal antiemetic regimens; nevertheless, these drugs have several unsatisfactory side effects, and the most effective preventive strategy has not yet been found.[13,14] Intravenous crystalloids and oral and IV fluids containing carbohydrates have been frequently utilised to treat PONV with positive outcomes, despite the lack of conclusive information supporting the effectiveness of perioperative fluid therapy and glucose delivery on PONV.[1,15] However, various authors suggested exploring it in various surgeries to confirm the result.[16,17]

Many earlier studies have compared the efficacy of oral carbohydrate fluid and intravenous fluid for the prophylaxis of PONV in various laparoscopic surgeries. For the prevention of PONV in patients having gynecological laparoscopic surgery, our research is the first to compare intravenous crystalloid fluid with preoperative oral carbohydrate fluid.

In the present study, the incidence of PONV was studied after giving either 10 ml/kg of intravenous crystalloid or 400 ml of oral 12% carbohydrate drink preoperatively. Vomiting was significantly less in Group CHO than in Group RL during the first 2 hours postoperatively (p value <0.05). The overall incidence of PONV was lower in the CHO group than in the RL group; however, the difference was not statistically significant.

The findings were consistent with those reported by Singh et al. They compared PONV in patients after giving 12.5% oral carbohydrate drink, a placebo drink, or kept fasted and observed significantly less incidence of nausea (52%, 87.5%, and 80% respectively) as well as vomiting (17.5%, 42.5%, and 47.5% respectively) with the oral carbohydrate drink during 0-4 hours in laparoscopic cholecystectomy surgery. The incidence of PONV and post-operative discomfort was shown to be positively impacted by preoperative beverages high in carbohydrates.[18]

In the last few years, some authors have also assessed the efficacy of oral carbohydrate-containing fluids given preoperatively, the night before surgery, and 2-3 hours before induction of anaesthesia to prevent PONV without complications.[5-7,10] Preoperative carbohydrate loading has been shown to lower insulin resistance and postoperative catabolism.[5] Oral glucose has been used extensively to relieve nausea through an unidentified mechanism. Sugar has been considered because high osmotic pressure reduces gastrointestinal tract muscular contractions. Hausel et al in their study observed a significantly lower occurrence of PONV during 12-24 hours period postoperatively as compared to fasting group (1.8% vs 13.7%) after the administration of 800 cc of a 12.5% oral carbohydrate beverage (Nutricia) on evening before surgery and two hours before to operation, 400 ml of the same beverage in patients undergoing laparoscopic cholecystectomy. However, no intergroup difference in PONV was observed for 0-12-hour and 0–24-hour periods after surgery.[1]

Intravenous crystalloids in varying volumes have been used to prevent PONV in various surgeries. Various authors observed that intravenous fluids, if given preoperatively in patients undergoing laparoscopic surgery, decreased the occurrence of nausea/vomiting significantly as compared to patients who had received standard fluid therapy.[19] It has also been observed that a large volume of Ringer's lactate was more effective in reducing the incidence and severity of PONV than a low volume.[12,20] Similarly, Sharma et al. compared the incidence of PONV using different volumes (10 ml/kg, 20 ml/kg, and 30 ml/kg) I.V. given preoperatively in patients undergoing laparoscopic cholecystectomy. They observed that vomiting occurred in 53%, 26%, and 10% patients in the 10 ml/kg, 20 ml/kg, and 30 ml/kg groups, respectively. The antiemetic requirement was also the least in the 30ml/kg group.[21] One significant etiological cause for PONV may be tissue hypoperfusion. After prolonged fasting, hypovolemia may lead to gastric mucosal hypoperfusion. However, research has shown that mucosal hypoperfusion may result from general anesthesia, increased intra-abdominal pressure from pneumoperitoneum during laparoscopy, and surgical stimulation without a drop in arterial pressure. During gynecologic laparoscopy, the Trendelenburg posture (head-down) exacerbates regional hypoperfusion as well. Intravenous fluid administration reduces hypovolemia and hypoperfusion. Even in the absence of a drop in blood pressure, mucosal hypoperfusion has been linked to fasting, general anesthesia, increased intra-abdominal pressure from pneumoperitoneum during laparoscopy, and surgical stimulation. So, loading the patient with either oral or intravenous fluids can decrease this hypovolemia and hypoperfusion.[22]

In our study, the difference in mean surgical duration between the two groups was 13.40 minutes, which was statistically significant. However, this difference in duration was not clinically important, as surgery duration was unrelated to PONV incidence.[23]

The group that received the carbohydrate drink had somewhat higher blood sugar levels before the induction of anaesthesia in the current trial, but the difference was not significant. Libiszewski et al. observed a similar result in their study after administering oral glucose solutions.[24]

In the present study, ketone bodies appeared in urine at 6 hours postoperatively in 16% patients of the RL group; none of the patients of the CHO group had ketone bodies in urine at the same time. At 60 minutes into the operation, blood sugar levels in both groups were much higher than they were before the operation. Our study results were comparable with previous studies using a carbohydrate drink or Ringer's lactate.[25] The presence of ketone bodies in urine was observed in both groups. They were significantly higher in the RL group [Figure 1]. An early appearance and a significantly higher fraction of patients testing

positive for ketone bodies in urine suggest that insulin resistance increased after surgery, leading to lipolysis in the fasting state. A carbohydrate drink probably helps lower insulin resistance, leading to less ketone body production and less ketone body appearance in urine. Similar results were observed by Maekawa et al.[26]

In this research, various patient satisfaction parameters like thirst, hunger, dryness of mouth, weakness, tiredness, giddiness, and restlessness were assessed from the patient in the form of a questionnaire before induction and 24 hours after surgery. Patients who received a carbohydrate drink showed a significant decrease in thirst and dry mouth throughout the preoperative period, but there was no change at the 24-hour postoperative time point. As shown in [Figure 3], patients who received carbohydrate drink were less hungry, but the difference was not significant preoperatively, however at 24-hour postoperative period patients who were given intravenous fluid were significantly hungrier than patients who received carbohydrate drink. There was no notable difference in fatigue, weakness, and restlessness between the two groups throughout the preoperative period. Patients who received a carbohydrate drink felt significantly more tired at the 24-hour postoperative period [Figure 3]. There were more positive effects on patient satisfaction parameters with the preoperative carbohydrate drink.

Yogendran et al. observed a lower incidence of thirst when 20 ml/kg of intravenous fluid was given preoperatively compared with 2 ml/kg. 27 In contrast, Magner and coworkers observed no difference in thirst when 30 ml/kg or 10 ml/kg Ringer's lactate was given.12 In another study by Sharma et al., the incidence of thirst was 33%, 20%, and 3% in patients who received 10 ml/kg, 20 ml/kg, and 30 ml/kg of Ringer's lactate, respectively.[28] During the preoperative waiting time, Nygren et al. found that drinking carbohydrates reduced thirst but not hunger. 8 Kenji et al observed the incidence of dry mouth and hunger: 12% and 32%, respectively, in patients who received a carbohydrate drink, and 65% and 52%, respectively, in fasted patients during the preoperative period.29 Similar results were reported by Hausel et al,[1] Another study by Sada et al. observed decreased thirst, hunger, mouth dryness, and weakness during the 24 hours after surgery with a carbohydrate drink.[15]

In a review by Meyer, 12 of 20 studies examining the effects of oral and IV preoperative carbohydrate loading on the incidence of postoperative nausea and vomiting in surgical patients found that either oral or IV preoperative carbohydrate intake decreased PONV or reduced antiemetic use. In contrast, the remaining studies found that these interventions had no discernible effect on PONV. Additionally, patients had shorter PACU stays, reduced insulin resistance, and less hunger and thirst. The author also suggested that more research is needed in the same field.[30]

Conclusion

Preoperative administration of 12% oral carbohydrate solution (apple juice) was effective in controlling vomiting in the immediate postoperative period compared with intravenous crystalloid in patients undergoing laparoscopic gynaecological surgery. Additionally, it led to improved patient satisfaction in the perioperative period and prevented ketosis in patients without any complications. Thus, a preoperative 12% oral carbohydrate drink (0.5 mL) 2-3 hours before induction of anaesthesia may be recommended for the prophylaxis of PONV, with improved patient satisfaction.

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Conflicts of interest

There are no conflicts of interest.

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