ORIGINAL ARTICLE

Preoperative carbohydrate nutrition reduces postoperative nausea and vomiting compared to preoperative fasting

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Background: The aim of this prospective, randomized, single-blinded study was to compare the effects of a carbohydrate drink 400 mL given 2 h before the surgery with preoperative overnight fasting on the gastric pH and residual volume, postoperative nausea and vomiting (PONV) and antiemetic consumption in patients undergoing laparoscopic cholecystectomy. **Materials And Methods:** Forty American Society of Anesthesiologists physical status I-II patients who underwent elective laparoscopic cholecystectomy. Randomized, prospective, controlled study, Gulhane Medical Faculty and Guven Hospital Department of Anesthesiology and Reanimation. Patients were randomly assigned into two groups: Pre-operative carbohydrate drink group (group C, n = 20) and preoperative fasting group (group F, n = 20). Group C was given a 400 mL carbohydrate drink 2 h before to the surgery. The patients of group F were fasted 8 h before the surgery. Both groups were operated under general anesthesia with volatile anesthetics. **Results:** Hemodynamic parameters, demographic data, gastric acidity and residual volumes were similar for both groups. No complications were observed. PONV and antiemetic consumption was lower in group C compared to group F (P = 0.001). Patient's satisfaction was higher in group C (P < 0.001). **Conclusion:** This study showed that pre-operative carbohydrate drink may be used safely and also improves patient's satisfaction and comfort in patients undergoing laparoscopic cholecystectomy.

Key words: Laparoscopic cholecystectomy, post-operative nausea and vomiting, pre-operative carbohydrate nutrition, pre-operative fasting

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INTRODUCTION

Pre-operative fasting is still a routine practice in many hospitals to avoid aspiration of gastric contents in the perioperative period. Recently, oral intake of carbohydrate solutions until 2 h before the surgery has been introduced to prevent unfavorable problems caused by dehydratation and hunger. Gastric transit times of these solutions are generally shorter than 2 h. It was reported that pre-operative oral carbohydrate solutions reduce post-operative thirst, hunger, and dehidratation, headache, nausea and vomiting in all age groups.[1-5]

Pre-operative fasting does not ensure neither gastric emptying nor reducing gastric volume and acidity. pH value of gastric content is between 1.0 and 3.5 in healty subjects. Gastric volume of the patients who were overnight fasted for elective surgery is generally more than 25 mL and pH value of gastric content lower than 2.5. Recent studies have shown that oral intake of clear liquids until 2-4 h before the surgery does not have any effect on gastric content and gastric acidity.[1-4]

Post-operative nausea and vomiting (PONV) is the most reported complication after anesthesia and still occurs in 20-40% of patients despite preventive measures. PONV may cause electrolyte imbalance, dehydratation, infections, and aspiration and also delay recovery and hospital discharge.[1-3,5]

In recent years, carbohydrate-rich drinks (CHO) have been designed to increase gastric emptying, to prevent hypoglycemia and to improve patient's comfort. This solution contains 12.5% carbohydrate, water, maltodextrin, fructose and aromatic compounds and provides 50 kcal/100 mL energy. The recommended use of the drink is oral intake of 800 mL in the evening and of 400 mL 2 h before the surgery.[3-7]

The aim of our study was to compare the effects of CHO given 2 h before the surgery with preoperative 8 h fasting on pre-operative anxiety, gastric volume and acidity, PONV, and consumption of antiemetic medication in the patients undergoing elective laparoscopic cholecystectomy.

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MATERIALS AND METHODS

Randomized, prospective, controlled study was conducted between December 2008 and March 2009 in the Gulhane Medical Faculty and Guven Hospital Department of Anesthesiology and Reanimation. After obtaining ethical committee approval (research project Number in 598), 40 American Society of Anesthesiologists (ASA) I-II patients, aged between 18 years and 60 years and scheduled for elective laparoscopic cholecystectomy were included into study. Adult patients scheduled for elective laparoscopic cholecystectomy, and who were eligible for intake of preoperative clear fluids according to the guidelines of the ASA,[1-3] were considered inclusion. Patients with conditions (including pharmacological treatments) that might impair gastrointestinal motility, gastro-oesophageal reflux, and those who had the potential for difficult airway management were therefore excluded. Additional exclusion criteria were history of motion sickness, diabetes mellitus, severe hepatic or renal failure, any endocrine disorder, allergy to the medications of the study, body mass index >30 and ASA physical status grade III or higher and pregnancy. Patients with suspected (jaundice or based on laboratory findings) or documented choledocholithiasis were not included. To achieve standardization of the duration of fasting before surgery in each group, patients whose operation was scheduled to start after noon were not included.

The patients were assigned, according to a computer generated randomization list, randomly divided into two preoperative treatment groups: Fasting from midnight (group F, $n = 20$) or preparation with CHO drink (group C, $n = 20$). The patients of group F were fasted for 8 h before the surgery, whereas group C received 400 mL of oral carbohydrate solution containing 12.5% glucose (Nutricia preop®; Nutricia, Zoetermeer, The Netherlands) 2 h before the surgery.[3] The patients, investigators and nursing staff were all blinded to the fasting and CHO drink. CHO drinks have previously been shown to be indistinguishable in taste, and the products were provided in identical packaging. The patients were explained how to use Verbal Descriptive Scale (VDS) and State — Trait Inventory (STAI) to grade their nausea and anxiety levels. VDS (0-4 point) was used for the severity of nausea and vomiting: No complaint, 0; mild degree of nausea, 1; moderate degree of nausea, 2; frequent vomiting (4 times), 3; severe vomiting (continuous vomiting), 4.[8,9] Preoperative anxiety is a very common phenomenon that adversely affects a patient's physical and psychological outcome. STAI tests were used to measure the anxiety level of the performers. Maximum and minimum scores are 80 and 20 points respectively while a score above ≥ 45 designated an anxious performer. Table 1 describes STAI.

All patients were scheduled for laparoscopic cholecystectomy, and the planned length of hospital stay was 24 h. For premedication, midazolam 2.5 mg i.v. at least 2 h after the morning fasting and CHO drink groups. On the operation day, the patients were taken into operation room and monitorized with non-invasive blood pressure (BP), electrocardiogram (ECG), heart rate (HR), pulse

Table 1: State–Trait Inventory (STAI) form

STAI form TX-1	None (1)	Some (2)	Excessive (3)	Completely (4)
I am calm at the moment				
I feel myself secure				
I am nervous at the moment				
I am in regret				
I am peaceful at the moment				
I am dispirited at the moment				
I am anxious about future events about me				
I feel myself relaxed				
I am anxious at the moment				
I feel myself comfortable at the moment				
I am self-confident				
I am angry at the moment				
I am nervous				
I feel my anger very tight				
I feel myself relaxed				
I am pleased from my state at the moment				
I am apprehensive at the moment				
I feel myself confused due to excitement				
I am joyful at the moment				
I am high spirited at the moment				

STAI=State–Trait inventory (STAI) form

oximetry, and end-tidal carbon dioxide. Hemodynamic parameters were recorded at induction, intubation, and then with 5 min intervals. After establishing an i.v. access and pre-oxygenization, general anesthesia was induced with i.v. 5 mg/kg thiopental sodium, 1 μg/kg fentanil and 0.1 mg/kg vecuronium. Trachea was intubated with an endotracheal tube (ETT) and anesthesia was maintained using 65% nitrous oxide and 1% sevofluorane (inspired concentration) in 35% oxygen. The ventilatory settings were adjusted as tidal volume: 6-8 mL/kg, f: 12/min and Positive end-expiratory pressure (PEEP): 5 cm H_2O. Ventilation was mechanically controlled and adjusted to keep end-tidal PCO_2 at 35-40 mm Hg. 1 μg/kg fentanil was given when mean arterial BP and HR exceeded 20% of preoperative control values. During laparoscopy, carbon dioxide was insufflated intraperitoneally to maintain an intra-abdominal pressure between 10 mm Hg and 15 mm Hg. At the end of surgery, the CO_2 was carefully evacuated by manual compression of the abdomen with open trocars.

0.9% NaCl isotonic was used for intraoperative and balanced electrolyte solutions for postoperative fluid replacement in both groups. Only intraoperative fluid requirement was given to group C, whereas group F received both intraoperative and pre-operative fluid requirements replacement.

A special data chart was prepared for each subject, and results for gastric residue pH and volumes were recorded prospectively by investigators who were blinded to study group. Samples were obtained from the fasting group 2 h before surgery to match the morning tests obtained for the treatment group and at the time of anesthesia induction. To obtain samples for gastric residue, a standard 16-Fr nasogastic tube was placed immediately after endotracheal intubation during anesthesia. To prevent it from affixing to gastric mocosa, the orogastric tube was moved slightly on an axial line; intermittent aspiration was applied, and measure gastric residual volume and pH values of gastric content were detected using a urine pH meter (Chemstrip 10 with SG Urine Test Strip, Roche Diagnostics, Indianapolis, IN, USA) within the first 10 min intraoperatively. A three-port technique with carbondioxide insufflation of the peritoneal cavity was used, with an insufflation pressure below 13 mm Hg. At the end of the surgery, volatile anesthetics were discontinued and 100% oxygene was given. The ETT was removed after sufficient respiration of the patient and reversal of neuromuscular block with 0.05 mg/kg neostigmin and 0.015 mg/kg atropin. Then the patients were taken to the post-operative care unit (PACU). 75 mg diclofenac sodium was used for post-operative pain relief. 1 mg/kg i.m. meperidine was given when visual analogue scale (VAS) score >3.

PONV scores and vital parameters were recorded in 1, 10, 15, and 30 min in the PACU. Patients whose vital parameters were stable were transferred to the ward. PONV scores were recorded during the 1st 24 h. Severity of PONV was assessed by an anesthesiologist who did not know the fasting or preparation with CHO drink used by the patient. Patients who received two or more points according to the VDS were treated with metoclopropamide 10 mg i.v.

Statistical analysis

SPSS 11.0 (SPSS, Inc., Chicago, IL, USA) was used for statistical analyses. All analyses were performed and presented on the basis of intention to treat. All means were presented with 95% confidence limits. Statistically, the average values of the groups were used with mean ± SD values. Demographic data were compared with Kruskal-Wallis test between study groups. Friedman's test was used to compare the effects of anesthetic techniques on hemodynamic parameters. Paired comparisons in the groups were done with Wilcoxon test with Bonferroni correction and inter groups paired comparisons with Mann-Whitney U test with Bonferroni correction. Kruskal-Wallis test was used for comparisons between groups. $P < 0.05$ considered statistically significant.

RESULTS

There was no statistically significant difference for demographic and surgical data, hemodynamic parameters and complications between groups, and are summarized in Tables 2 and 3. When sedation levels were compared, it was found that pre-operative anxiety scores of the patients in group F were higher than group C ($P = 0.035$) [Table 3]. Residual volume and pH value of gastric contents were similar in two groups [Table 3]. VDS scores were compared in the PACU and in the clinic during 1st 24 h [Table 4 and Figure 1].

In the PACU period, VDS scores and antiemetic consumptions were not statistically different between groups. However, at the end of the study, it was found that overall VDS scores ($P < 0.001$) and antiemetic consumptions ($P = 0.001$) were significantly lower in the group C compared to group F [Table 4 and Figure 1]. Patient's satisfaction was higher in group C ($P < 0.001$).

Table 2: Demographic variables

Group parameters	Preoperative fasting (*n*=20)	Carbohydrate drink (*n*=20)	*P* value
Age (years)	45.73±10.385	42.57±14.42	0.349
Height (cm)	164.72±7.656	168.9±9.05	0.556
Weight (kg)	72.95±12.936	72.10±12.13	0.375
ASA (I/II)	15/5	14/6	0.899

P<0.05 considered statistically significant. ASA=American society of anesthesiologists

Table 3: Patient numbers whose hemodynamic parameters was out of ±20% of baseline values in the intraoperative and postoperative period, complication rates, preoperative sedation scores, gastric residual volumes and pH values and intergroups comparison

Group Parameters	Preoperative fasting (*n*=20)	Carbohydrate drink (*n*=20)	*P* value
	n_{dev}	n_{dev}	
MAP (%)	0 (0)	3 (14.2)	0.04
HR (%)	0 (0)	10 (47.6)	0.106
Desaturation (%)	0[a] (0[b])	0 (0)	
Complication (%)	0 (0)	0 (0)	
Preoperative anxiety score	24.38	16.62	0.035*
Gastric pH	19.15	21.85	0.47
Residual volume	21.05	19.95	0.77

n: Number of patients in the groups; n_{dev}: Patient numbers whose parameters was out of ±20% of baseline values; [a]The number of patients whose SpO_2<% 92; [b]The ratio of n_{dev} to the number of all patients. *P<0.05 considered statistically significant. MAP=Mean arterial pressure; HR=Heart rate

Table 4: Comparison of postoperative nausea and vomiting scores and total antiemetic consumption between groups

	Groups	*n*	n_{dev}	*P* value
VDS PACU	Fasting	20	23,82	0.07
	CHO drink	20	17,18	
VDS 24 h	Fasting	20	27,98	<0.001*
	CHO drink	20	13,02	
PACU drug	Fasting	20	23,00	0.18
	CHO drink	20	18,00	
Drug 24 h	Fasting	20	27,50	0.001*
	CHO drink	20	13,50	

P<0.05 considered statistically significant. The ratio of n_{dev} to the number of all patients. *P*<0.05 considered statistically significant. Metoclopropamide 10 mg was used intravenously as an anti-emetic. PONV=Postoperative nausea and vomiting; PACU=Post anesthesia care unit; VDS=Verbal descriptive scale; n_{dev}: Patient numbers whose parameters was out of ±20% of baseline values; CHO drink: carbohydrate-rich; Metoclopropamide 10 mg was used intravenously as an anti-emetic

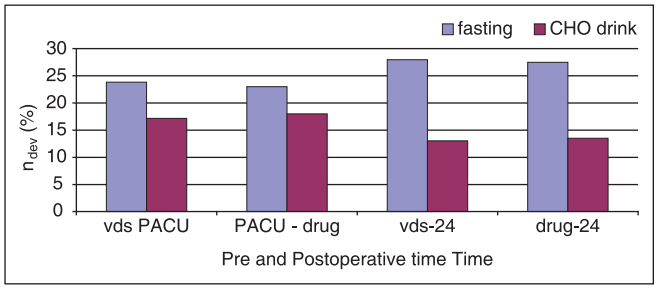

Figure 1: Comparison of postoperative nausea and vomiting scores and total antiemetic consumption between groups. The ratio of n_{dev} to the number of all patients. *P < 0.05 considered statistically significant. Metoclopropamide 10 mg was used intravenously as an anti-emetic. PONV: Postoperative nausea and vomiting; PACU: Post anesthesia care unit; VDS: Verbal descriptive scale; n_{dev}: Patient numbers whose parameters was out of ± 20% of baseline values

DISCUSSION

Many national anesthetic clinics have changed their preoperative fasting criteria and recommended oral intake of clear fluids until pre-operative 2 h. The exception to this recommendation is emergence surgery and motility disorders.[1,3-5] Although acidic fluids exist in the stomach during the induction of anesthesia, there was not any reported increase of the incidence for aspiration, regurgitation or morbidity and mortality in the healthy patients undergoing elective surgery.[8]

The report by ASA Task Force on pre-operative fasting to reduce the risk of pulmonary aspiration in 1999 revealed that fasting from intake of clear liquids for 2 or more hours before procedures requiring anesthesia is appropriate.[1,4,5] A specially designed pre-operative CHO drink is a clear fluid too and the recommended use of it is 800 mL oral intake at the midnight and 400 mL 2 h before the surgery.[9-12]

Hausel *et al*.[13] have randomized 252 elective surgery patients to preparation with a CHO drink, placebo (flavored water) and overnight fasting. CHO group was given a 800 mL CHO drink in the evening and 400 mL at least 2 h before the surgery, whereas, placebo group consumed the same amount of flavored water at same times. They have found that the incidence of hunger, thirst and anxiety was lower and patient's comfort was higher in CHO group compared to other groups throughout the study period.[13] In our study, we found that 400 mL CHO drink given 2 h before the surgery decreased the sedation scores at the morning of the surgery and also decreased pre-operative anxiety scores compared to overnight fasting.

Nutrients, which carbohydrate concentration is below 8% produce an insulin response. CHO comprises 12.5% carbohydrate. In addition, CHO increases gastric emptying because its osmolarity is low (<295 mosm/kg) and contains maltodextrine.[12] Nygren *et al*.[14] compared gastric emptying of a 400 mL carbohydrate-rich drink with 400 mL water taken 4 h before the surgery. Initially, water emptied more rapidly than carbohydrate. However, after 90 min, the stomach was emptied regardless of the solution administered.

In another study by Nygren *et al*.[15] it was found that residual gastric volume and pH value of gastric content did not differ between oral intake of 400 mL CHO drink 4 h before the surgery and pre-operative fasting. Yagci *et al*.[16] compared the effects of pre-operative carbohydrate loading (800 mL of a carbohydrate-rich fluid on the evening before surgery and 400 mL of the same fluid 2 h preoperatively) and pre-operative fasting on glucose metabolism and gastric contents in patients undergoing cholecystectomy or thyroidectomy. Pre-operative plasma glucose levels were found to remain significantly higher in patients who had received the carbohydrate-rich fluid. Serum insulin levels that were elevated initially in the carbohydrate group returned to control levels by the time of anesthesia

induction. There was no statistical difference with respect to gastric residue contents or gastric fluid pH.

Hausel *et al*.[13] reported that single dose oral intake of 400 mL clear carbohydrate drink was leaving the stomach in 90 min without increasing gastric residual volume and affecting acidity. We found that gastric acidity and residual volume did not differ between carbohydrate drink and fasting groups. This result is supported by the study of Hause *et al*.[13] who reported that single dose oral intake of 400 mL clear carbohydrate drink was emptying from the stomach in 90 min without increasing gastric residual volume and affecting acidity.

Hausel *et al*.[17] randomized 172 patients undergoing elective laparoscopic cholecystectomy to either preoperative fasting, intake of CHO drink or placebo drink. Nausea and pain scores were evaluated with a VAS and PONV episodes were recorded up to 24 h after surgery. The incidence of PONV and VAS was lower in the CHO than in the fasted group between 12 h and 24 h after surgery. Nausea scores in the fasted and placebo groups were higher after operation than before admission into hospital, whereas there was no significant change in the CHO group.[17] In our study, we compared PONV using VDS between CHO and fasting groups during PACU period and also at 24 h after surgery. During the PACU period, VDS scores were similar between groups, but VDS scores were significantly lower in CHO group whereas antiemetic consumption was higher in fasting group at 24 h.

In our study, we found that the incidence of PONV and VAS was lower in the CHO than in the fasted group between 12 h and 24 h after surgery. However, Bisgaard *et al*.[3] reported that similar VAS pain scores on the day after laparoscopic cholecystectomy have been reported previously.[3]

A recently published placebo-controlled study of 94 patients from Denmark[3] was unable to shov any significant beneficial effects of CHO on post-operative well-being, including PONV, after laparoscopic cholecystectomy. We found that pre-operative carbohydrate drink may be used safely and also improves patient's satisfaction and comfort in patients undergoing laparoscopic cholecystectomy.

In a study by Lauwick *et al*.[18] 200 patients undergoing thyroidectomy were given 400 mL carbohydrate or 100 mL aspartam containing drink 2 h before the surgery. They found that the incidence of PONV was similar between groups, but thirst, hunger, and anxiety were lower and patient's comfort was higher in carbohydrate group compared to aspartam group.[18] As a difference, we found that PONV scores were not different between carbohydrate and fasting groups in the PACU period, but at 24 h, PONV was lower in carbohydrate group and also antiemetic consumption was higher in the fasting group. In addition, sedation scores at the operation day were lower in carbohydrate group, whereas, anxiety was higher in pre-operative fasting group before the induction of anesthesia. This findings supports the results of Lauwick[18] study.

In conclusion, we found that oral intake of 400 mL carbohydrate drink 2 h before the elective surgery increased patient's wellness and reduced anxiety. It also did not increase the risk of aspiration without any effect on gastric acidity and residual volume. PONV scores and antiemetic consumption were reduced with CHO drink administration. We concluded that pre-operative carbohydrate drink may be used safely and also improves patient's satisfaction and comfort in patients undergoing laparoscopic cholecystectomy.

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