EFFECTS OF PREOPERATIVE ORAL CARBOHYDRATES AND TRACE ELEMENTS ON PERIOPERATIVE NUTRITIONAL STATUS IN ELECTIVE SURGERY PATIENTS

Yoshimasa Oyama*, Hideo Iwasaka*, Keisuke Shiihara*, Satoshi Hagiwara*, Nobuhiro Kubo**, Yutaka Fujitomi***, Takayuki Noguchi*

Abstract

Purpose: In order to enhance postoperative recovery, preoperative consumption of carbohydrate (CHO) drinks has been used to suppress metabolic fluctuations. Trace elements such as zinc and copper are known to play an important role in postoperative recovery. Here, we examined the effects of preoperatively consuming a CHO drink containing zinc and copper.

Methods: Subjects were 122 elective surgery patients divided into two groups (overnight fasting and CHO groups); each group was further divided into morning or afternoon surgery groups. Subjects in the CHO group consumed 300 mL of a CHO drink the night before surgery, followed by 200 ml before morning surgery or 700 ml before afternoon surgery (≥2 hours before anesthesia induction). Blood levels of glucose, nonesterified fatty acids (NEFA), retinol-binding protein, zinc, and copper were determined.

Results: One subject in the CHO group was excluded after refusing the drink. There were no adverse effects from the CHO drink. NEFA levels increased in the fasting groups. Although zinc levels increased in the CHO group immediately after anesthesia induction, no group differences were observed the day after surgery.

Conclusion: Preoperative consumption of a CHO drink containing trace elements suppressed preoperative metabolic fluctuations without complications and prevented trace element deficiency. Further beneficial effects during the perioperative period can be expected by adding trace elements to CHO supplements.

* M.D. Ph.D, Department of Anesthesiology and Intensive Care Medicine, Oita University Faculty of Medicine, Oita, Japan.

** M.D, Ph.D, Department of Surgery, Oita Kouseiren Tsurumi Hospital, Oita, Japan.

*** M.D., Ph.D, Department of Breast Surgery, Oita Kouseiren Tsurumi Hospital, Oita, Japan.

Corresponding Author: Yoshimasa Oyama M.D, Department of Anesthesiology and Intensive Care Medicine, Oita University Faculty of Medicine, 1-1 Idaigaoka-Hasamamachi, Yufu City, Oita 879-5593, Japan. Tel: +81-97-586-5943, Fax: + 81-97-586-5949. E-mail: oyama@oita-u.ac.jp

Introduction

In the last decade, the customary practice of overnight fasting before elective surgery has been reconsidered, and a shorter fasting time has been advised. Intake of water, black coffee, tea, or fruit juice without pulp up to 2 to 3 h before anesthesia induction does not increase the risk of pulmonary aspiration and is recommended by anesthesiology societies in many countries[1-4]. However, while thirst, unfitness, and malaise prior to surgery can be improved by preoperative intake of such drinks[5], metabolism is unchanged because the drinks contain few calories. In recent years, preoperative management has focused on maintaining physiologic function and enhancing postoperative recovery. The Enhanced Recovery After Surgery (ERAS) critical care protocol recommends the preoperative consumption of a carbohydrate (CHO) drink[6], which helps maintain the nutritional state and suppress catabolism due to surgical stress[7]. Furthermore, it has been reported to enhance recovery and reduce the duration of hospitalization[8].

Many nutrients are important for postoperative recovery, including the trace elements zinc (Zn) and copper (Cu), which are important in wound healing. Zn is required by enzymes involved in cell division and proliferation, and Cu is required for initiate the cross-linking of elastin and collagen[9,10]. Surgical stress increases Zn and Cu consumption[11], increases their excretion in urine and discharge through drains[12-14], and causes their direct loss by bleeding. Moreover, the demand for these elements increases during the postoperative assimilation phase, resulting in perioperative Zn and Cu deficiencies. Low preoperative concentrations of Zn have been observed in patients with delayed postoperative wound healing[15], and satisfactory outcomes have been obtained for burn patients by early administration of trace elements[16]. However, studies evaluating the effects of preoperative supplementation of trace elements in elective surgery patients have not been reported.

In order to evaluate the nutritional state resulting from preoperative nutrition management, a dynamic index capable of detecting subtle changes is needed. Generally, a protein with a short half-life is used for this purpose. Among such proteins, retinol-binding protein (RBP) is considered a good indicator of daily nutritional changes[17], and is well-suited for evaluating nutritional states that may be influenced by preoperative nutrition management.

Preoperative oral CHO administration is used effectively throughout Europe and the United States. However, conventional overnight fasting is still used as standard practice in some nations[18,19].

The aim of this study was to evaluate the effects of an 18% CHO drink containing trace elements on preoperative nutritional state and trace element levels as compared with a conventional fasting protocol.

Methods

This study was conducted between May and August 2009. The study protocol was approved by the Medical Ethics Committee of Oita Kouseiren Tsurumi Hospital, and was carried out in accordance with the Helsinki Declaration. For all subjects, we provided a full explanation of the aims and methods of the study and obtained their informed consent.

Patients

Subjects were 122 elective surgery patients. Selection criteria were: scheduled surgery; age, 20-89 years; body mass index (BMI), 18-35; and American Society of Anesthesiologists (ASA) physical status (PS) classification, 1-3. Exclusion criteria were: diabetes, abnormal glucose tolerance, upper gastrointestinal disease (gastroesophageal reflux, hiatal hernia), ileus, use of drugs that cause delayed gastric emptying, and patients that needed to begin fasting two days before surgery. One subject in the CHO consumption group refused the CHO drink after we obtained consent, and was therefore excluded.

Patients were divided into two groups according to the period of study: 1) The first 2-month period involved the conventional overnight fasting protocol at this hospital (fasting group, n = 61); 2) the next 2-month period used the new protocol of preoperative CHO drink supplementation (CHO group, n = 60). Both groups were further divided into morning surgery (AM group, 9:30-10:00 surgery suite entry) and afternoon surgery (PM group, 14:00-16:00 surgery suite entry). Patient characteristics are shown in Table 1.

Table 1
Patient characteristics and demographic data

	AM fasting	PM fasting	AM CHO	PM CHO
	n = 26	n = 35	n = 27	n = 33
Sex (M/F)	9/17	17/18	7/20	15/18
Age (y)	62 ± 11	61 ± 18	59 ± 12	61 ± 15
Height (cm)	157 ± 9	159 ± 9	159 ± 9	157 ± 9
Weight (kg)	59 ± 12	60 ± 12	61 ± 10	58 ± 9
BMI (kg/m^2)	24 ± 4	24 ± 4	24 ± 3	24 ± 3
ASA (I/II/III)	4/22/0	5/29/1	6/20/1	7/25/1
Duration of surgery (min)	178 ± 81$^{\#}$	132 ± 64	135 ± 60	132 ± 72

Data are presented as absolute numbers or mean ± SD. CHO = carbohydrate, M = male, F = female, BMI = body mass index, ASA = classification of illness according to the American Society of Anesthesiology. $^{\#}P$ <0.05 vs. PM fasting, AM CHO, and PM CHO groups (ANOVA).

Study protocol

For all patient groups, the final meal before surgery was at 18:00. The fasting group began their fast at 21:00 on the night before surgery. The CHO group ingested a CHO drink (Isocal™, Arginaid® drink, Nestle) the CHO drink and then waited 2-3 hours before surgery: AM surgery group (300 ml from 21:00 throughout the night before surgery and 200 ml from 6:30 to 7:30 on the day of surgery), and PM surgery group (300 ml from 21:00 throughout the night before surgery, and on the day of surgery, 200 ml from 6:30 to 7:30, 300 ml from 9:00 to 10:00, and 200 ml from 11:00 to 12:00) (Fig. 1). The contents of the Arginaid® drink are shown in Table 2. In the fasting group, intravenous crystalloid fluid solution without sugar was initiated at 9:00 for morning and afternoon surgeries. In the CHO group, intravenous crystalloid fluid solution without sugar was initiated at 9:00 for morning surgeries and 13:00 for afternoon surgeries. Blood samples for measuring blood glucose, nonesterified fatty acid (NEFA), RBP, Zn, Cu, blood urea nitrogen (BUN), and creatinine were collected immediately after anesthesia induction, and blood samples for Zn and Cu measurements were also collected the following morning. To assess patient discomfort before surgery, we asked questions regarding thirst, hunger, and anxiety using a questionnaire immediately after they entered the surgery suite. Responses were given using a 5-point Likert scale (1: not at all, 2: hardly, 3: neither, 4: somewhat, 5: very much).

Fig. 1
Timeline of perioperative carbohydrate (CHO) drink consumption

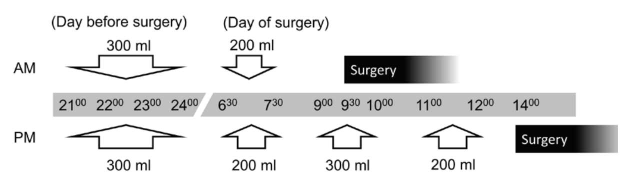

Table 2
Contents of the preoperative carbohydrate drink suppleent (ISOCAL® Arginaid® drink)

	Typical contents per 100 ml
Carbohydrates	18 g
Protein	2 g
L-arginine	2 g
Phosphorus	18 mg
Zinc	8 mg
Copper	0.8 mg

Anesthesia and surgery

No premedication was administered, and patients walked into the surgery suite. If there were no contraindications, patients received an epidural catheter at an appropriate location before general anesthesia in thoracic surgery, orthopedic surgery of the lower limbs, or urinary tract surgery. Epidural anesthesia was initiated before general anesthesia with mepivacaine. When combined with epidural anesthesia, general anesthesia was induced with propofol (2 mg/kg) and vecuronium (0.1 mg/kg), and maintained by sevoflurane (1%3%-). When not combined with epidural anesthesia, general anesthesia was induced with propofol (1.5 mg/kg), vecuronium (0.1 mg/kg), and remifentanil (0.5 μg/kg/min); sevoflurane (1%-3%) and remifentanil (0.2-0.5 μg/kg/min) were used for maintenance. Heart rate and blood pressure were recorded at the following time periods: immediately before anesthesia induction, and 1, 2, and 5 minutes after anesthesia induction. The anesthesiologist maintained normovolemia throughout the surgery and gave a single injection of ephedrine (4 mg) as a vasopressor to maintain mean systolic blood pressure at 60-70 mmHg. When the target blood pressure could not be maintained, the anesthesiologist initiated continuous infusion of dopamine (2-5 μg/kg/min).

Assessment of gastric content volume

To determine residual gastric content, a double-lumen gastric tube was inserted immediately after anesthesia induction. Insertion into the stomach was confirmed by auscultation and aspiration. The gastric tube was moved several times, and gastric juice was aspirated at several locations. The amount of gastric juice was then measured.

Biochemical analysis

Blood glucose levels were measured immediately after collection by the glucose oxidase method using a blood gas analyzer (ABL-555, Radiometer, Copenhagen, Denmark). Blood samples for measuring NEFA, RBP, Zn, Cu, BUN, and creatinine were centrifuged immediately after collection and stored at -20˚C until analysis.

NEFA levels were determined by enzymatic methods (SRL, Tokyo, Japan), and RBP levels were determined with nephelometric methods (SRL, Tokyo, Japan). Serum BUN (urease-glutamate dehydrogenase method), creatinine (sarcosine oxidase-peroxidase method), Zn (5-Br-PAPS colorimetric method; reference range118-66 μg/dl), and Cu (3,5-DiBr-PAESA colorimetric method; reference range 71-132 μg/dl) were determined by an automated analyzer (TBA-200FR; Toshiba Medical Systems, Tokyo, Japan) and commercial kits (Shino-Test, Tokyo, Japan for creatinine, Zn, and Cu; SYSMEX, Hyogo, Japan for BUN).

Statistical analysis

Parametric data are expressed as mean ± standard deviation (SD); group differences were determined by one-way ANOVA or Student's *t*-test, and differences in repeated measurements by Fisher's protective least-squares difference and paired samples *t*-test.

Nonparametric data are expressed as medians and quartiles; group differences were determined by the Kruskal-Wallis test and differences in repeated measurements by the Mann-Whitney U-test. P <0.05 was considered significant. Statistical analysis was carried out with StatView for Windows, version 5.0 (SAS Institute Inc.).

Results

Demographic data

Of the 122 elective surgery patients, one subject in the CHO group refused the CHO drink after we obtained consent and was thus excluded; 121 subjects completed the study. There were no differences in patient characteristics before surgery; however, surgery duration for the AM fasting group was longer than that of the other patient groups (Table 1).

The types of surgery performed are shown in Table 3. Thoracic surgeries were lobectomies and partial lobectomies, breast surgeries were mastectomies and breast preservations, gastrointestinal surgeries were laparoscopic cholecystectomies, plastic surgeries were body surface surgeries, orthopedic surgeries were joint replacement and spinal surgeries as well as osteosynthesis of broken limbs, and urinary tract surgeries were prostatectomies and bladder removal. Given the hospital's surgery schedule, no orthopedic or urinary surgeries were performed in the morning (AM) surgery groups.

Table 3
Surgical procedures

	AM fasting n =26	PM fasting n =35	AM CHO n =27	PM CHO n =33
Thoracic, n	8	2	8	2
Breast, n	11	6	7	8
Digestive, n	4	3	5	2
Urologic, n	0	5	0	5
Plastic surgery, n	3	8	7	9
Orthopedic, n	0	11	0	7

CHO = carbohydrate.

Table 4
Preoperative patient characteristics

	AM fasting n =26	**PM fasting n =35**	**AM CHO n =27**	**PM CHO n =33**
Glucose (mg/dl)	102 ±14	93 ±11 §§	104 ±16	105 ±11
NEFA (μEq/L)	679 ±237	927 ±317 #	475 ±278 **	589 ±357 ††
RBP (mg/dl)	4.1 ±1.4	3.7 ±1.1	3.8 ±0.9	5.0 ±6.6
BUN (mg/dl)	15 ±7	14 ±4	14 ±3	16 ±4
Creatinine (mg/dl)	0.8 ±0.4	0.7 ±0.2	0.7 ±0.1	0.8 ±0.2

Data are presented as mean ± SD. CHO = carbohydrate, NEFA = nonesterified fatty acids, RBP = retinol binding protein. §§P <0.01 vs. AM fasting, AM CHO, and PM CHO groups; #P <0.05 vs. AM fasting; **P <0.01 vs. AM fasting; ††P <0.01 vs. PM fasting.

Preoperative fasting duration was 751 ± 6 min for AM fasting and 1013 ± 13 min for PM fasting. The time from final CHO drink consumption to anesthesia was 201 ± 4 min for the AM CHO group and 209 ± 11 min for the PM CHO group. In the CHO groups, the time from the final meal excluding drink consumption was 754 ± 9 min for AM CHO and 1023 ± 15 min for the PM CHO group, which did not differ significantly from fasting durations in the fasting groups.

Effects of CHO consumption on preoperative biochemical data

As shown in Table 4, blood glucose levels immediately after anesthesia induction were lower in the PM fasting group than in other patient groups. However, NEFA increased more in the PM fasting group (927 ± 54 μEq/L) than the AM fasting group (679 ± 46 μEq/L; *P* = 0.022), and was lower in the AM CHO group (475 ± 54 μEq/L) than the AM fasting group (679 ± 46 μEq/L; *P* = 0.016). Likewise, there was a significant decline in the PM CHO group (589 ± 62 μEq/L) compared with the PM fasting group (927 ± 54 μEq/L; *P* <0.001). In contrast, RBP, BUN, and creatinine levels did not differ among patient groups.

Effects of CHO on serum trace element levels

Table 5 shows that, immediately after anesthesia induction, serum levels of Zn were higher in the CHO groups than in the fasting groups (AM fasting vs. AM CHO: 67 ± 2 μg/dl vs. 105 ± 4 μg/dl, P <0.001; PM fasting vs. PM CHO: 69 ± 2 μg/dl vs.100 ± 4 μg/dl, *P* <0.001). However, on postoperative day 1, Zn levels had decreased in the CHO groups and were not significantly different from the fasting groups.

Serum levels of Cu did not differ among groups immediately after anesthesia induction or on postoperative day 1. However, in the CHO group, Cu levels on postoperative day 1 were lower than those observed immediately after anesthesia induction.

Table 5
Trace elements

		AM fasted	**PM fasted**	**AM CHO**	**PM CHO**
		n =26	n =35	n =27	n =33
Zn (μg/dl)					
	Anesthesia induction	67 ± 9	69 ± 10	105 ± 19**	100 ± 21 ††
	Day 1	62 ±10 ##	59 ±15 ##	65 ±10 ##	65 ±21 ##
Cu (μg/dl)	Anesthesia induction	96 ±16	96 ±17	96 ±15	102 ±23
	Day 1	95 ±14	93 ±16 #	96 ±16	95 ±21 ##

Data are presented as mean ± SD. CHO = carbohydrate. **P <0.01 versus AM fasting; ††P <0.01 vs. PM fasting; ## P <0.01 vs. anesthesia induction; ##P <0.01 vs. anesthesia induction.

Effects of CHO on preoperative discomfort

Answers to the questionnaire evaluating thirst, hunger, and anxiety before anesthesia induction did not differ significantly among groups (Table 6).

Effects of CHO on perioperative clinical data

Heart rate and blood pressure at each time periods did not differ significantly across groups. At 1, 2, and 5 minutes after anesthesia induction, heart rate and blood pressure were lower than those observed immediately before anesthesia induction (Table 7). During the anesthesia induction period, inotrope requirements did not differ across groups.

For PM surgeries, preoperative intravenous fluid replacement was lower in the CHO groups than the fasting groups due to protocol differences; however, no differences in intravenous fluid replacement amounts were observed among patient groups during surgery.

We did not observe a single case of pulmonary aspiration or other adverse event associated with CHO drink consumption. Mean gastric juice volumes immediately after anesthesia induction were low, and did not differ among groups (Table 8). Maximum volumes of gastric juice were 83 ml (AM fasting), 60 ml (PM fasting), 71 ml (AM CHO), and 33 ml (PM CHO).

Discussion

The present study shows that preoperative supplementation of a CHO drink containing trace elements suppresses preoperative increases in NEFA levels and decreases in Zn levels. The CHO drink was a hypertonic solution containing protein and trace elements; therefore, gastric retention time may have been prolonged compared with that of an isotonic CHO drink. Henriksen et al. reported that preoperative supplementation with a drink containing 12.5% CHO and 3.5% protein did not increase gastric juice volume. Likewise, we did not observe increased gastric juice volume or pulmonary aspiration, demonstrating the safety of this perioperative protocol.

The CHO group took more water during the preoperative period than did the fasting group. However, during the anesthesia induction period, heart rate and blood pressure did not differ significantly across groups, indicating that the balance of bodily fluids did not differ significantly. We also observed no group-dependent differences in intraoperative fluid volume or urinary volume. These observations may indicate that dehydration caused by overnight fasting as well as that caused by CHO drink replacement is within a normal range of homeostasis, and is mainly regulated by renal function.

In the CHO groups, preoperative NEFA levels were low compared to those of the fasting groups due to lipolysis suppression, which is consistent with previous reports by Soope et al. and Henriksen et al.[7,20]. Elevated NEFA levels suppress phosphoinositide 3-kinase in muscle cells, thereby lowering glucose uptake and promoting insulin resistance[21]. Accordingly, glucose oxidation and nonoxidative glucose disposal have been prevented by intravenous administration of lipids to healthy adults[22]. Preoperative consumption of a CHO drink has also been shown to attenuate insulin resistance[23], possibly by reducing NEFA levels.

RBP changes were not observed in the present study. The half-life of RBP is 10 to 20 h, suggesting that RBP would respond to subtle differences in the nutritional state caused by brief perioperative fasting or CHO drink consumption. Fasting times were 12 to 17 h, which may have been too short to be captured by RBP changes. Deteriorating renal function can also increase RBP [24], but no differences in renal function were observed in the study.

Wound repair is an important postoperative process, and delayed wound healing is a serious problem. The trace elements Zn and Cu are important in wound healing. Zn is essential for cell division and proliferation, and demand for Zn increases after surgery. In a state of deficiency, Zn is supplied by bone, muscle, and the liver, which generally store Zn. In the present study, we observed that preoperative serum Zn concentrations were decreased to the lower end of the reference range in the fasting groups, which reflects the notion that serum Zn is taken from storage. However, surgical stress increases Zn demand[11] as well as depletes it through draining[12-14] and bleeding. Thus, Zn deficiencies are likely during the perioperative period. In contrast, we observed higher serum Zn concentrations in the CHO groups. This suggests

Table 6
Preoperative discomfort evaluated by 5-point Likert scale

	AM fasting n = 26	**PM fasting n = 35**	**AM CHO n = 27**	**PM CHO n = 33**
Thirst	2.5 (0.5-4.5)	3 (1-5)	2 (0-4)	2 (0.75-3.25)
Hunger	2.5 (0.5-4.5)	4 (2-6)	3 (1-5)	3 (1-5)
Anxiety	2 (1-3)	2 (1-3)	1 (0-2)	2 (1-3)

Data are presented as median (interquartile range: 25^{th}-75^{th} percentiles) CHO = carbohydrate.

Table 7
Time course of changes in heart rate, blood pressure during anesthesia induction

	HR (beats/min)				**SBP (mmHg)**				**DBP (mmHg)**			
	T0	**T1**	**T2**	**T5**	**T0**	**T1**	**T2**	**T5**	**T0**	**T1**	**T2**	**T5**
AM-fasted	71 ± 18	61 ± 19*	58 ± 18*	55 ± 16*	133 ± 21	91 ± 21*	80 ± 19*	75 ± 16*	73 ± 12	48 ± 10*	43 ± 11*	40 ± 10*
PM-fasted	71 ± 12	63 ± 13*	59 ± 11*	57 ± 13*	144 ± 21	103 ± 20*	91 ± 19*	82 ± 18*	77 ± 11	56 ± 11*	50 ± 11*	45 ± 9*
AM-CHO	70 ± 14	61 ± 15*	58 ± 14*	57 ± 12*	123 ± 18	90 ± 17*	82 ± 15*	76 ± 15*	70 ± 11	50 ± 10*	45 ± 10*	42 ± 9*
PM-CHO	71 ± 13	62 ± 12*	59 ± 12*	58 ± 12*	140 ± 24	95 ± 23*	86 ± 17*	83 ± 18*	75 ± 15	53 ± 13*	45 ± 13*	45 ± 13*

Data are presented as mean ± SD. CHO = carbohydrate, HR = Heat rate, SBP = systolic blood pressure, DBP = diastolic blood pressure, T0 = immediate before anesthesia induction, T1 = 1 min after anesthesia induction, T2 = 2 min after anesthesia induction, T5 = 5min after anesthesia induction. $^{*}P$ <0.05 vs. T0.

Table 8
Perioperative clinical data

	AM fasting n = 26	**PM fasting n = 35**	**AM-CHO n = 27**	**PM-CHO n = 33**
Preoperative fluid (ml)	161 ± 49	357 ± 159	140 ± 52	191 ± 96**
Intraoperative fluid (ml)	1082 ± 493	1237 ± 629	798 ± 290	1130 ± 936
Blood loss (ml)	91 ± 136	172 ± 253	46 ± 64	138 ± 253
Urine (ml)	395 ± 318	303 ± 289	281 ± 175	194 ± 133
Gastric fluid volume (ml)	12 ± 22	11 ± 16	13 ± 18	10 ± 12

Data are presented as mean ± SD. CHO = carbohydrate. $^{**}P$ <0.01 vs. PM fasting.

that ingesting a CHO drink with trace elements may maintain not only serum Zn concentrations, but also its storage in bone, muscle, and the liver, which may help increase Zn demand during the perioperative period. We observed lower Zn concentrations the day after surgery in all groups, but group-related differences did not exist. We did not administer any trace elements postoperatively, as this yields a decrease in Zn concentrations, as demonstrated in the fasting groups immediately after anesthesia induction. Acute stress induces metallothionein, which has a strong affinity for Zn[25] and redistributes Zn to the liver and other tissues for protein synthesis, thereby reducing serum Zn levels[26]. Zorrilla et al. reported that low preoperative serum Zn concentrations were predictive of delayed wound healing following total hip replacement[15]. Maintaining preoperative serum Zn concentrations may help redistribute Zn to the wound, which improves wound healing.

Many metalloenzymes contain copper that reacts with oxygen. In particular, monoamine oxidase and lysyl oxidase are necessary for cross-linking elastin and collagen in wound healing[5,6]. In the present study, we observed postoperative changes in Cu levels in the PM surgery group. Berger et al. reported that trauma causes little change in Cu concentration, and that recovery is fast[10]. Our findings are consistent with those results.

Although differences in thirst, hunger, or anxiety before anesthesia induction were not significant, preoperative CHO drink supplementation appeared to slightly reduce patient discomfort. Using a visual analog scale, Hausel et al. reported that thirst and hunger were reduced by preoperative consumption of a CHO drink[5]. Shorter fasting times can reduce discomfort associated with a surgical procedure; thus preoperative drink supplementation can mitigate, even if only slightly, the stress experienced by patients before surgery.

In the present study, patients received the preoperative drink containing 18% CHO, amino acids, and trace elements. All patients tolerated the drink well. Preoperative consumption of a drink containing 12.5% CHO has been reported to suppress surgical stress-induced catabolism, thereby attenuating insulin resistance[23]. Furthermore, this treatment enhanced postoperative recovery and shortened hospital stays[8]. Preoperative consumption of a drink containing 18% CHO, such as the one used in the present study, may also enhance postoperative recovery.

Given that this study was carried out at a single facility, there are a number of limitations. By grouping subjects according to morning or afternoon surgery, seasonal fluctuations in metabolism may have influenced the results. In addition, the postoperative observation period was short, so the long-term effects of CHO consumption (days hospitalized, wound healing) were not assessed. To confirm our findings, long-term studies at multiple institutions will be needed.

In conclusion, compared to conventional preoperative fasting, preoperative consumption of a CHO drink containing trace elements suppressed preoperative metabolic fluctuations without causing adverse effects, and trace element deficiency was circumvented. Further, the drink appears to reduce patient anxiety. Additional benefits during the perioperative period can be expected by adding trace elements to the preoperative CHO drink supplementation protocol.

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