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Case Report

Preoperative Oral Carbohydrate Loading in Pancreaticoduodenectomy

Kum-Hee Son,[1,3] So-Young Kim,[1] Yeong-Ah Cho,[1,3] Gyung-Ah Wie,[1,3] Sung-Sik Han,[2,3] Sang-Jae Park[2,3]

[1]Department of Clinical Nutrition, National Cancer Center, Goyang 10408, Korea
[2]Center for Liver Cancer, National Cancer Center, Goyang 10408, Korea
[3]Nutrition Support Team, National Cancer Center, Goyang 10408, Korea

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Correspondence to
Gyung Ah Wie
Department of Clinical Nutrition, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang 10408, Korea.
Tel: +82-31-920-0261
Fax: +82-31-920-0269
E-mail: gawie@ncc.re.kr

Conflict of Interest
The authors have no potential conflicts of interest to disclose.

ABSTRACT

Overnight fasting before elective surgery has been the routine to reduce the risk of pulmonary aspiration. Recently, several international guidelines for preoperative fasting recommend to intake carbohydrate-containing fluids up to 2 to 3 hours before the induction of anesthesia to improve postoperative recovery. Based on the recommendations, we developed a "preoperative carbohydrate diet" provided for the preoperative patients. The purpose of this case report is to share our experience of applying preoperative carbohydrate loading prior to surgery.

Keywords: Preoperative carbohydrate loading; Preoperative fasting; Insulin resistance

INTRODUCTION

Traditionally, overnight fasting before elective surgery has been the routine in medical practice for risk reduction of pulmonary aspiration of gastric contents [1]. But, some studies have shown that prolonged fasting does not reduce gastric contents, and instead causes an increase in patient discomfort [2,3]. Consequently, several recent international guidelines have recommended to shorten the duration of preoperative fasting for enhancing recovery after surgery [4,5].

Surgical trauma induces a 'stress response' which involves a series of physiologic reactions and aims to promote recovery from impaired metabolic and physiological homeostasis. It also increases the release of stress hormones and inflammatory cytokines that lead the body into a catabolic state and insulin resistance. These hormones and cytokines induce the hepatic production of glucose by gluconeogenesis and glycogenolysis, and reduce glucose uptake in peripheral tissues, thus leading to postoperative hyperglycemia. In addition, they stimulate proteolysis and lipolysis. Increased insulin resistance can be sustained for 3-4 weeks after surgery and the degree of increased insulin resistance is affected by the extent of surgery, the amount of blood loss, and the duration of preoperative fasting. Prolonged preoperative fasting induces the utilization of nutrients stored in the body, and increases patient's discomfort and anxiety. It can accelerate the release of stress hormones, thereby aggravating insulin resistance [6-8,13].

Table 1. Recommendations from the Enhanced Recovery After Surgery (ERAS) of preoperative oral carbohydrate loading

Subject	Recommendation grade
Gastrectomy	Strong
Pancreaticoduodenectomy	Strong
Elective colonic surgery	Strong
Elective rectal pelvic surgery	Strong
Radical cystectomy	Strong

It is well known that insulin resistance is related to delayed wound healing, increased morbidity/mortality, and prolonged hospital stay [8]. Therefore, maintaining an anabolic state before surgery and reducing of postoperative insulin resistance are very important for enhancing recovery after the surgery [6].

Several international anesthesiology societies recommend the reduction in preoperative fasting time in order to enhance recovery after the surgery. These new guidelines recommend the intake of solid foods for up to 6 hours before the induction of anesthesia and the intake of clear liquids up to 2 hours before the induction of anesthesia. Especially, Enhanced Recovery After Surgery (ERAS) Society and European Society of Anesthesiology (ESA) recommend the intake of carbohydrate-containing fluids up to 2 hours prior to surgery (**Table 1**) [5,6,9-12].

The purposes of preoperative carbohydrate loading are to maximize glycogen storage in the body as an energy source in order to minimize subsequent degradation of body tissues and reduce insulin resistance. A suitable carbohydrate-containing drink (CHOD) should contain 12.5% maltodextrin for gastric emptying. The recommendation is to intake 100 g of carbohydrate (800 mL of CHOD) in the evening before surgery, and 50 g of carbohydrate (400 mL of CHOD) until 2 hours before surgery. Insulin levels at the time are similar to those observed after normal diet and thus, the body can maintain an anabolic state [6,13].

Based on these recommendations, a 'preoperative CHO loading diet (Soft Fluid Diet and Soft Blended Diet)' was developed to facilitate recovery from the illness after surgery and to increase patient's satisfaction in the National Cancer Center. The purpose of this case report is to share our experience of applying a preoperative carbohydrate loading prior to surgery.

CASE

A 'preoperative CHO loading diet' was given to patients scheduled to undergo hepatobiliary-pancreatic (HBP) surgery, including pancreaticoduodenectomy, for which surgery CHO loading is strongly recommended by the ERAS program. To evaluate the effect of preoperative carbohydrate loading on clinical outcome, it was necessary to estimate several factors including gastric residual volumes (GRV) before surgery, nutritional factors, subjective well-being, and insulin resistance. This study was approved by the Institutional Review Board of the National Cancer Center (NCC 2016-0104).

A 52-year-old man was diagnosed with cancer of the common bile duct and admitted into the National Cancer Center for pancreaticoduodenectomy. The patient's height was 166.4 cm, body weight was 67.0 kg, body mass index was 24.2 kg/m^2. The patient did not have any underlying disease, including diabetes mellitus or gastro-esophageal reflux disease. Surgery was scheduled for 09:00 AM on the following morning.

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Table 2. Preoperative carbohydrate loading protocol

	Preoperative day #1	Operative day
Diet	- Lunch: regular diet - Dinner: preoperative CHO diet (SBD)*	- Breakfast: preoperative CHO diet (SFD)† up to 05:30 AM

CHO, carbohydrate; SBD, soft blended diet; SFD, soft fluid diet.

*100 mL of rice porridge with 800 mL of carbohydrate-containing drink; †400 mL of carbohydrate-containing drink.

Table 3. Nutrition facts of carbohydrate drink

Nutrients	Composition per 100 mL
Energy	50 kcal
Carbohydrate	12.8 g
Sugar	2 g
Protein	0 g
Fat	0 g
Saturated fatty acid	0 g
Trans fatty acid	0 g
Cholesterol	0 mg
Sodium	52 mg
Potassium	48 mg

Preoperative day #1

A registered dietitian assessed the patient's nutritional status using the scored Patient-Generated Subjective Global Assessment (PG-SGA), the patient was classified as moderate malnourition (SGA-B) due to weight loss and reduced food intake owing to abdominal discomfort. Also, a registered dietitian explained to the patient about the diet protocol, including CHOD before surgery (**Table 2**). The patient consumed the entire of 'preoperative CHO loading diet (SBD)' without any problems. Nutrient facts of provided CHOD were recorded in the **Table 3**.

Operative day

On the day of surgery, the patient was given the 'preoperative CHO loading diet (SFD)' including 400 mL of CHOD and allowed to drink this until 05:30 AM. He was asked to score his subjective well-being with the 10 cm visual analog scale (VAS) prior to surgery. The patient's subjective well-being scores were as follows: thirst-2; hunger-3; comfort-5; anxiety-1; fatigue-2.

Plasma glucose and insulin concentrations were measured and homeostatic model assessment-insulin resistance (HOMA-IR) was calculated in order to determine insulin resistance before the surgery. Plasma glucose and insulin concentrations were 112 mg/dL and, 8.2 μU/mL, respectively, while HOMA-IR was 2.27. Gastric residual volume (GRV) was measured preoperatively via L-tube aspiration.

The patient consumed 400 mL of CHOD up to 4 hours before surgery and GRV was 5 mL. Following the surgery, the patient was sent to the surgical intensive care unit and received postoperative medical care for pancreaticoduodenectomy.

Postoperative day #1

The patient was provided with routine postoperative care. In the morning, the patient's plasma glucose and insulin concentrations were 187 mg/dL and 4.8 μU/mL, respectively, and HOMA-IR was 2.22 (**Table 4**). Compared to the day of surgery, the HOMA-IR on postoperative day #1 had not been increased. The patient was sent to a general ward later that afternoon.

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Table 4. Factors related to insulin resistance

Variables	Operative day	Postoperative day #1
Glucose, mg/dL	112	187
Insulin, μU/mL	8.2	4.8
HOMA-IR*	2.27	2.22

HOMA IR, homeostatic model assessment-insulin resistance.

*HOMA-IR = [plasma insulin (μU/mL) × plasma glucose (mmoL/L)] / 22.5.

Discharge

The patient received 'post-pancreaticoduodenectomy diet' and was recovered well in the general ward without any complications. The patient was discharged 14 days after the surgery and body weight was 61.2 kg.

DISCUSSION

Many recent studies have shown that preoperative carbohydrate loading does not influence gastric residuals and reduces patient discomfort [2,16]. Moreover, it has been shown to be effective in reducing insulin resistance [13]. Jonas et al. [2] reported no difference in gastric residue two hours after drinking 400 mL of a 12.5% carbohydrate drink when compared to an equivalent volume of water. Yuill et al. [14] showed that the decrease in muscle mass after upper gastrointestinal surgery in preoperative carbohydrate loading group was less than that in fasting group. Noblett et al. [15] also reported enhanced recovery of a hand grip strength and a reduced length of hospital stay in patients with colectomy after preoperative carbohydrate loading. According to a recent Cochrane review, preoperative well-being and postoperative nausea and fatigue were improved after preoperative carbohydrate loading. The case in our hospital showed almost no gastric residual volume and low scores of patient discomfort including thirst and hunger after preoperative oral carbohydrate loading.

After surgery, blood glucose levels are increased due to the decrease in insulin secretion, and insulin resistance is also increased in response to stress. The mechanisms by which preoperative CHO loading attenuates postoperative insulin resistance are still unclear. But, some studies showed that preoperative carbohydrate loading can reduce insulin resistance by glucose uptake in the muscle due to insulin secretion [3,18]. Fujikuni et al. [17] showed that the postoperative insulin resistance in patients with gastrectomy was decreased by preoperative carbohydrate loading compared with fasting. In this patient, insulin resistance did not increase, presumably due to preoperative oral carbohydrate loading.

Therefore, we think that preoperative oral carbohydrate loading may be helpful for the recovery of patients. Currently, preoperative oral carbohydrate loading is only recommended to patients undergoing hepato-biliary-pancratic surgery at our hospital, but we are on the research for the application of preoperative oral carbohydrate loading to the patients with other cancers. However, there are almost no studies on the amount of CHOD intake for Korean subjects. Hence, further studies should be conducted in this field.

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