Title:

Oral carbohydrate loading with 18% carbohydrate beverage alleviates insulin resistance

Introduction

Preoperative 12.6% oral carbohydrate loading is an element of the Enhanced Recovery After Surgery (ERAS) protocol aimed at alleviating postoperative insulin resistance; however, in Japan, beverages with 18% carbohydrate content are generally used for preoperative carbohydrate loading. We hypothesized that an 18% carbohydrate drink could prevent the aggravation of insulin resistance; therefore, we investigated the effect of 18% carbohydrate loading on preventing the decrease in insulin sensitivity in healthy volunteers.

Methods

Six healthy volunteers participated in this crossover-randomized study and were segregated into 2 groups. In the carbohydrate-load group (group A), the volunteers fasted after 9 p.m. on the day before the experiment, ingested 375 mL (300 kcal) of Arginaid Water (Nestle Health Science, Tokyo, Japan) between 9 p.m. and 12 a.m. on the same day, and then ingested 275 mL (200 kcal) of the beverage at 6:30 a.m. on the morning of the experiment. In the control group (group B), the volunteers fasted on the day before the experiment after 9 p.m. and only ingested water. On the day of the experiment, blood was collected at 8:30 a.m. from both the groups. Hyperinsulinemic normoglucoe clamping using the STG-22 artificial pancreas (Nikkiso, Tokyo, Japan) was then performed for 2 h. The items evaluated were as follows: the glucose infusion rate (GIR) where insulin resistance finally stabilized; catabolic state, evaluated by measuring blood ketone body levels before clamping; the levels of the cytokines IL-1β, IL-6, and TNF-α, measured before clamping; as baseline evaluation, fasting blood glucose and insulin levels were measured before clamping. Serum ketone body, blood glucose, serum insulin, and serum cytokine levels
were determined. P < 0.05 was considered statistically significant.

Results

Six healthy volunteers participated in the study: 5 men and 1 woman. The average age was 29 ± 3 years, height was 166 ± 6 cm, weight was 62 ± 13 kg, and BMI was 22 ± 4 kg/m2. Levels of blood glucose, insulin, and cytokines at the start of the clamp were similar in both the groups. The GIR in group A was significantly higher than that in group B (11.5 ± 2.4 vs. 6.2 ± 2.2 mg/kg/min, p = 0.005), while blood ketone body levels were significantly lower in group A (22 ± 4 vs. 124 ± 119 µmol/L, p = 0.04).

Discussion

This study showed that the decrease in insulin sensitivity could be significantly prevented with preoperative 18% carbohydrate loading, similar to the improvement achieved with the 12.6% carbohydrate loading recommended by the ERAS protocol.

Preventing the decrease in insulin sensitivity can play an important role in improving the prognosis of patients undergoing surgery. Even healthy, non-diabetic patients who fast before elective surgery have a 50% chance of developing insulin resistance aggravation from the preoperative fasting period. Our data showed that fasting-induced insulin resistance in healthy participants could be reversed by preoperatively administering an 18% carbohydrate solution. The treatment also led to a reduction in blood ketone body levels, indicating a lower degree of the catabolic state.

The present study revealed that the oral administration of a higher concentration but lower amount of carbohydrate led to almost identical effects in preventing the decline in insulin sensitivity. We consider that the total amount of carbohydrate consumed, rather than the concentration, may be important in preventing the decrease in insulin sensitivity. Although the use
of a 12.6% carbohydrate drink is recommended by the ERAS protocol, such a beverage is not available in Japan. Therefore, these results are an important step toward the implementation of a modified ERAS protocol in Japanese hospitals.

In conclusion, our study showed that ingestion of an 18% carbohydrate drink could prevent the decrease in insulin sensitivity and suppress catabolism in healthy volunteers. Although further clinical studies on postoperative patients are required to determine whether preoperative 18% carbohydrate loading contributed to improvements in patient outcome, the results provide vital information for implementing a modified ERAS protocol in countries where the recommended 12.6% carbohydrate solution cannot be obtained.