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Does preoperative oral carbohydrate treatment reduce the postoperative surgical stress response in lumbar disc surgery?

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ABSTRACT

Objectives: Surgical trauma produces metabolic and hormonal responses, which are characterized by insulin resistance. Due to extension of the preoperative fasting period, which increases the magnitude of postoperative insulin resistance, preoperative oral carbohydrates (POC) have been developed.
Patients and methods: This prospective, randomized, controlled study was performed on 43 ASA I–II patients undergoing elective microsurgical lumbar discectomy. The intervention group received oral carbohydrate solution 800 mL the night before and 400 mL 2 h prior to operation. The other group fasted for 8 h prior to operation. Blood samples were obtained the day before the operation, before induction of anesthesia, after skin incision, 1 h, 2 h, 6 h and 24 h following skin incision. Blood glucose, plasma insulin, cortisol and interleukin-6 (IL-6) levels were determined. The primary endpoint was to assess the effect of POC treatment on insulin resistance and surgical stress response following lumbar disc surgery. The secondary endpoint was to assess POC's effects on postoperative nausea and vomiting.
Results: The serum insulin levels were higher before induction of anesthesia in the study group and returned to fasted group levels by 2 h after skin incision. The plasma IL-6 levels were higher in the intervention group at 6 h after the skin incision. There were no differences between the two groups with respect to blood glucose, plasma cortisol levels and the incidence of nausea and vomiting.
Conclusion: This study suggests that use of POC treatment does not attenuate development of insulin resistance in patients undergoing lumbar disc surgery.

1. Introduction

Surgical trauma produces metabolic, hormonal and hemodynamic responses in the body. This surgical stress response is characterized by insulin resistance, gluconeogenesis, lipolysis and protein breakdown, which result in hyperglycemia and negative nitrogen balance [1]. The magnitude of these changes is proportional to the duration of pre and postoperative fasting period, type of anesthesia, magnitude of surgery, amount of preoperative blood loss, severity of postoperative pain and duration of postoperative immobilization [2–4]. The development of postoperative insulin resistance may increase morbidity, mortality and length of hospital stay [5,6].

Traditionally 6–8 h of fasting is needed before elective surgery to reduce the risk of pulmonary aspiration at the time of anesthesia induction [7]. Because extension of the preoperative fasting period increases the magnitude of the postoperative insulin resistance [8], many anesthesiology guidelines now recommended intake of clear fluids up to 2 h before induction of anesthesia [9]. Over the last decade, carbohydrate rich beverages have been developed that at the proper concentration and osmolality empty from the stomach within 90 min in healthy subjects. Several studies have examined the effect of preoperative carbohydrate treatment on postoperative insulin resistance [10–13]. Some of these studies showed that pre-

Abbreviations: POC, preoperative oral carbohydrates; ASA, American Society of Anesthesiologists; IL-6, interleukin-6; Group CH, the intervention group received oral carbohydrate solution before the operation; Group Fast, this group fasted before the operation; PCA, patient controlled analgesia; Baseline, morning before the operation; Before OP, before induction of anesthesia; GLUT, glucose transporting proteins; HOMA-IR, the homeostatic model assessment-insulin- resistance equation; PONV, the postoperative nausea and vomiting.

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operative oral carbohydrate (POC) treatment reduces postoperative insulin resistance [10,12], but others did not [14,15]. As far as we know, the effect of POC treatment on surgical stress response has not been investigated in patients undergoing lumbar disc surgery.

The primary endpoint of the present study was to assess the effect of POC treatment on insulin resistance and surgical stress response during the first 24 h following lumbar disc surgery. The secondary endpoint was to assess the effects of POC treatment on postoperative nausea and vomiting.

2. Patient and methods

This prospective, randomized and controlled study was performed after approval from the Ethics Committee of Cerrahpasa School of Medicine (no: 24655). Forty-three ASAI-II patients with written informed consent, aged between 18 and 70 years scheduled for elective microsurgical lumbar discectomy and/or laminectomy under general anesthesia were included in the study. Patients presenting with any of the conditions below were excluded from the study: metabolic, endocrine and liver diseases, obesity, gastroesophageal reflux, mental illness, dementia, pregnancy, fever, infection, potential for difficult airway management and more than 500 mL peroperative bleeding.

At the time of admission patients were randomized to one of two groups using sealed opaque envelopes. The intervention group (Group CH) received 12.5% oral carbohydrate solution (285 mOsm kg^{-1}, Nutricia Preop) 800 mL at between 21:00 and 24:00 the night before and 400 mL at 06:00 which was 2 h prior to operation. The other group (Group Fast) fasted for 8 h prior to operation. All patients were admitted to the operation theater at the same time periods (07:30–08:30).

In the operating room, after routine monitoring, anesthesia was induced with propofol (1.5–2 mg kg^{-1}), vecuronium (0.1 mg kg^{-1}), remifentanil, (0.1 μg kg^{-1}) and maintained with sevoflurane (1–1.5 mean alveolar concentration) in oxygen/air (fraction of inspired oxygen of 0.40), remifentanil (0.05–0.1 μg kg^{-1} min^{-1}) and vecuronium (1–2 μg kg^{-1} min^{-1}). Peroperative analgesia was maintained with remifentanil (0.03–0.05 μg kg^{-1} min^{-1}) and morphine (0.05–0.1 mg kg^{-1}). Subcutaneous bupivacaine (0.05%, 2 mg kg^{-1}) was injected before skin incision. Residual muscle relaxation was reversed with atropine (0.01 mg kg^{-1}) and neostigmine (0.02 mg kg^{-1}) at the end of surgery. All patients received morphine using a patient controlled analgesia (PCA) device for 24 h postoperatively. The PCA solution contained 100 mg morphine in 100 mL normal saline. The PCA was set to administer a bolus dose of 1 mg on demand with a lockout period of 7 min.

For the analysis of blood glucose and plasma insulin levels blood samples were obtained from every patient the morning before the operation (Baseline), in the operating room before induction of anesthesia (Before OP), after skin incision (Skin incision), and 1 h, 2 h, 6 h and 24 h after the skin incision. Hemodynamic parameters were recorded at the same intervals. Plasma cortisol levels were assessed in the samples at periods Baseline, Before OP, 2 and 24 h after the skin incision. At periods Baseline, Before OP, 6 and 24 h after the skin incision plasma IL-6 levels were also determined. All blood samples were obtained through an intravenous catheter in an antecubital vein. At Baseline and 24 h following skin incision blood samples were obtained after a light breakfast. Nausea and vomiting were recorded at periods Baseline, Before OP, 6 and 24 h after the skin incision. Patients did not receive antiemetic prophylaxis. Postoperative nausea and vomiting were treated by 8 mg ondansetron.

Oral diet and fluids were permitted after surgery as soon as possible.

Table 1
Patient characteristics.

	Group CHn = 20	Group Fastn = 20
Age, years (mean ± SD)	48.95 ± 11.51	45.25 ± 7.23
Female gender, n (%)	10 (50%)	10 (50%)
Body weight (kg), (mean ± SD)	74.95 ± 11.85	75.9 ± 13.47
Height (cm), (mean ± SD)	168.25 ± 10.06	169.15 ± 9.07
Body mass index (kg/m^2), (mean ± SD)	26.57 ± 1.18	26.63 ± 1.68
ASA physical status (1/2) (number)	13/7	12/8
Duration of surgery, minutes (mean ± SD)	72.75 ± 29.06	80 ± 32.11

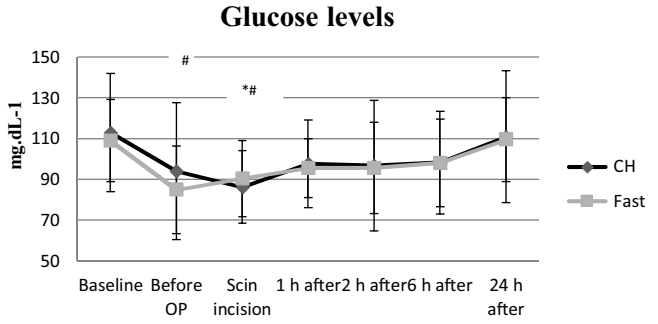

Fig. 1. Blood glucose levels at each indicated time intervals (mean ± SD).
*: The blood glucose levels were lower compared to the Baseline, and 24 h after the Skin incision in the Group CH ($p < 0.05$).
#: The blood glucose levels were lower compared to the Baseline and 24 h after the Skin incision in the Group Fast ($p < 0.05$).

Blood glucose was measured with the glucose oxidase method (Accutrend Alpha, Roche, Switzerland). The samples were centrifuged and frozen immediately until analysis for the other measurements. Serum insulin and cortisol levels were analyzed by radio-immuno-assay (the electrochemiluminescence immunoassay "ECLIA", Roche, Switzerland). Serum IL-6 levels were analyzed by enzyme-linked-immuno-sorbent-assay (ELISA) (Diaclone Research, France).

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) for Windows 15.0. The differences in ASA, gender, duration of surgery, body weight, height and body mass index between groups were analyzed by using Pearson's chi-square test.

The hemodynamic values, blood glucose, plasma insulin, cortisol and IL-6 levels were analyzed by repeated measures of analysis of variance (ANOVA) with the post-hoc Bonferroni correction test. Group comparisons were performed by the student's *t* test.

3. Results

Forty-three patients were enrolled in this study. Three patients were excluded from the study. The surgery was postponed to the afternoon for 2 patients. One patient refused to drink the morning dose of the oral carbohydrate solution.

The study groups were similar with respect to age, gender, body weight, height, body mass index, ASA physical status and duration of surgery (Table 1). Hemodynamic parameters were not different between the groups.

The blood glucose levels were lower at the Skin incision compared to the Baseline ($p < 0.01$) and the 24 h after the Skin incision ($p < 0.05$) in the Group CH. The blood glucose levels were lower at the Before OP and the Skin incision compared to the Baseline ($p < 0.001$, $p < 0.05$ respectively) and the 24 h after the skin incision ($p < 0.001$, $p < 0.05$ respectively) in the Group Fast. The blood glucose levels were not different between the groups at each indicated time intervals (Fig. 1).