

PREPARATION OF PATIENTS SUBMITTED TO THYROIDECTOMY WITH ORAL GLUCOSE SOLUTIONS

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The aim of the study was to determine postoperative insulin-resistance in patients subject to total thyroidectomy, the prevalence of subjective feelings of hunger immediately before surgery, and the incidence of nausea/ vomiting after surgery in patients prepared for elective operations by means of oral glucose solutions.

Material and methods. The study group comprised 115 patients, including 71 patients prepared for surgery by means of oral glucose solutions (12.5% glucose) administered 12 and 3 hours before the procedure, at a dose of 800 and 400 ml. The control group comprised 44 patients prepared for surgery by means of the traditional manner- the last meal was served before 2pm the day before the surgical procedure, while fluids before 10pm. Considering both groups, we evaluated glucose and insulin levels three times, as well as determined the insulin-resistance ratio (HOMA-IR) 24 before, and 12 hours and 7 days after surgery. The incidence of nausea and vomiting after surgery, and the subjective feeling of hunger before surgery were also evaluated.

Results. Statistically significant differences considering insulin level and HOMA-IR values were observed during the II and III measurements. The glucose and insulin values, and the HOMA-IR insulin-resistance ratio, showed no statistically significant differences during measurement I. No statistically significant glucose level differences were observed during measurements II and III. A significantly greater subjective feeling of hunger before surgery and nausea/vomiting afterwards were observed in the control group.

Conclusions. The preparation of patients with oral glucose solutions decreases the incidence of postoperative (thyroidectomy) insulin-resistance, and occurrence of nausea/vomiting during the postoperative period.

Key words: postoperative insulin-resistance, thyroidectomy, response to injury

The surgical procedure, due to its invasive character, regardless the disease, initiates a cascade of defensive reactions connected with the trauma. Elective surgery enables the surgeon to optimally prepare the patient and select the therapeutic strategy, as to minimize the possible consequences of the operation. The increasing medical knowledge, understanding of the physiology and pathophysiology, enables

to show the importance of proper nutrition of the body in situations of psychological and physical stress connected with the injury, including surgical trauma.

The first publications which demonstrated carbohydrate balance disturbances in response to stress or trauma date back to the middle of the nineteenth century. Reyboso et al. observed glucosuria in patients anesthetized with ether,

while Claude Bernard in 1887, based on animal model investigations noted the occurrence of hyperglycemia during hemorrhagic shock (1). Initially these phenomena were considered as a valid defensive mechanism built on a given stress. However, Van den Berghe et al. published a study in 2001, considering more than 1500 patients treated at the Intensive Care Unit following surgical, cardiosurgical, neurosurgical, and thoracosurgical procedures, as well as severe injuries and burns, demonstrating that intensive insulin therapy contributed to a reduction in mortality (by 43%) and risk of significant complications (by 34%). The above-mentioned study showed that prolonged hyperglycemia in critical patients, not only is undesirable, but is also toxic and may cause many complications (2).

Bicarbonate mechanism disorders after perioperative trauma are directly associated with the inflammatory, neurological, and endocrine response to stress. The injury initiates an immune response through the activation of proinflammatory cytokines, such as IL-1, IL-6, and TNF- α , which activate the hypothalamic-pituitary-adrenal axis. As a result of the release of stress hormones, such as catecholamines, cortisol, glucagon, and growth hormone one may observe increased glycogenolysis and gluconeogenesis. Additionally, glucose uptake is reduced by the insulin-resistant muscular and adipose tissues. The reduced activity of the glucose transporter GLUT4 of the cellular membrane of the muscles and fat, as a consequence of increased insulin-resistance is of great significance, considering the above-mentioned mechanism. Due to prolonged stress one may observe exceeded compensatory possibilities of the organism. Prolonged hyperglycemia with increased expression of glucose transporters GLUT1 and GLUT3 (independent of insulin), located in the cells of the nervous system, epithelium, as well as alveolar and smooth muscle cells increases the risk of direct toxicity of glucose. Hyperglycemia-stimulated insulin secretion becomes insufficient to minimize the consequences of glucotoxicity (2-5).

Bicarbonate homeostasis imbalance, as a consequence of postoperative insulin-resistance may lead towards significant complications. In light of contemporary publications proper patient preparation can help reduce the

risk of insulin-resistance, being a consequence of perioperative trauma. Oral administration of highly energetic bicarbonate solutions, prior to elective surgery may reduce the effect of night fasting, enabling to maintain hepatic glycogen reserve, reduces stress before surgery, and increases the insulin-sensitivity of tissues (6, 7).

The aim of the study was to determine postoperative insulin-resistance in patients subject to total thyroidectomy, the prevalence of subjective feelings of hunger immediately before surgery, and the incidence of nausea/vomiting after surgery in patients prepared for elective operations by means of oral glucose solutions.

MATERIAL AND METHODS

The investigated group comprised 115 patients qualified for thyroidectomy, due to goiter presence. The study comprised patients in whom imaging examinations showed no retrosternal nodular goiters, and preoperative fine-needle aspiration biopsy of the thyroid gland showed no presence or suspicion of malignant lesions.

The study group (Group I) comprised 71 patients (F: 45 – 63.38%, M: 26 – 36.62%), aged between 22 and 77 years. The above-mentioned patients received 800ml of a 12.5% glucose solution 12 hours before the procedure and 400ml, three hours before surgery.

The control group (Group II) comprised 44 patients (F: 28 – 63.63%, M: 16 – 36.36%), aged between 22 and 78 years, qualified for elective thyroidectomy. The above-mentioned group was prepared for surgery by means of the traditional manner: the last meal was administered before 2pm, and oral fluids before 10pm the day before the operation.

In both groups the glucose and insulin levels were evaluated three times: 24 hours before, 12 hours and 7 days after surgery (measurements were marked as I, II and III, respectively). The glucose level was estimated by means of the enzymatic method with hexokinase. The insulin level was estimated by means of the hemiluminescence ECLIA method.

The HOMA-IR method was used, considering insulin-resistance determination. The coefficient was calculated after each measurement

of glucose and insulin levels, according to the following formula: fasting glucose (mg/dl) x fasting insulin (mmunits/ml) / 22.5.

In both groups we evaluated the following diagnostic parameters: age, height, weight, BMI, subjective feeling of hunger reported by the patient on the day of the surgical procedure, and occurrence of nausea/vomiting during the perioperative period.

The study comprised patients without a history of diabetes mellitus, primary arterial hypertension, and obesity.

All patients were subject to the same general anesthesia. The duration of the procedure ranged between 37 and 68 minutes (average-52 min.).

RESULTS

The average patient age considering both groups amounted to 51.26 years, SD \pm 13.61 (group I – 50.90 years, SD \pm 13.00; group II – 51.84 years, SD \pm 14.69; $p > 0.05$), while the

BMI- 26.42 SD \pm 3.01 (group I – 26.68, SD \pm 2.76, group II – 26.01, SD \pm 3.36; $p > 0.05$). Tables 1, 2, 3 presented results of selected glucose and insulin level measurements, as well as the insulin-resistance ratio. The glucose, insulin, and HOMA insulin-resistance ratio showed no statistically significant differences, considering measurement I. There was no statistically significant difference between glucose measurements II and III. A statistically significant difference in the insulin level and HOMA-IR ratio was observed in case of measurements II and III. Statistical analysis was performed by means of the U Mann-Whitney test.

Considering the 71 study group patients nausea/vomiting was observed in 9 (12.68%) patients, while in the control group –18 (40.91%) ($p < 0.001$). The feeling of hunger on the day of surgery was observed in 14 (19.72%) study and 37 (84.09%) control group patients. There was a significant correlation when comparing the subjective feeling of hunger between both groups ($p < 0.001$). Statistical

Table 1. Statistical analysis of glucose level measurements in the investigated groups

	Group I	Group II	Statistical significance
Measurement I	91,35 mg/dl SD \pm 7,88	88,82 mg/dl SD \pm 7,36	$p > 0,05$
Measurement II	93,17 mg/dl SD \pm 10,84	95,37 mg/dl SD \pm 11,99	$p > 0,05$
Measurement III	90,44 mg/dl SD \pm 7,46	91,11 mg/dl SD \pm 6,22	$p > 0,05$

Table 2. Statistical analysis of insulin level measurements in the investigated groups

	Group I	Group II	Statistical significance
Measurement I	6,53 μ U/ml SD \pm 2,84	6,94 μ U/ml SD \pm 3,25	$p > 0,05$
Measurement II	7,56 μ U/ml SD \pm 4,59	13,98 μ U/ml SD \pm 9,02	$p < 0,001$
Measurement III	6,34 μ U/ml SD \pm 3,15	7,71 μ U/ml SD \pm 3,67	$p < 0,05$

Table 3. Statistical analysis of the HOMA-IR insulin-resistance ratio in the investigated groups

	Group I	Group II	Statistical significance
Measurement I	1,49 SD \pm 0,71	1,55 SD \pm 0,78	$p > 0,05$
Measurement II	1,80 SD \pm 1,27	3,47 SD \pm 2,56	$p < 0,001$
Measurement III	1,45 SD \pm 0,83	1,75 SD \pm 0,87	$p < 0,05$

analysis was performed by means of the chi-square test.

DISCUSSION

The first definition of the stress response as a programmed, coordinated, and adaptive process enabling survival was defined by Selye. The reaction of the organism to trauma is multilevel. The increased activity of the autonomic nervous system, activation of the hypothalamus-pituitary-adrenal axis, and intensity of the inflammatory response lead towards insulin-resistance, glucose intolerance and subsequent hyperglycemia, the so-called "trauma diabetes" (2, 8).

The influence of the stress response to insulin-resistance after surgery has been the subject of research since the nineties of the past century. Thorell et al. observed decreased insulin-sensitivity in 32% of patients subject to reconstructive inguinal hernia surgery, and in 52% subject to open cholecystectomy. In both groups the Authors also observed, increased catecholamine, cortisol, and growth hormone levels, which suggests a significant correlation between the severity of the inflammatory response, and intensification of insulin-resistance (9). Thorell et al. published a study one year thereafter concerning open cholecystectomy showing a statistically significant increase in insulin resistance during the first day after surgery (10).

Berggren et al. demonstrated reduced myocardial damage measured by means of creatinine kinase levels (CK-MB) in patients subject to coronary artery bypass grafting (CABG) after previous preparation by means of intravenous bicarbonate solutions, administered at a dose of 1liter, 12 hours before planned surgery (11).

Nygren et al. presented results considering treatment of patients subject to hip replacement surgery after preparation with oral carbohydrate solutions. In case of the study group they observed decreased insulin-resistance (by 37%), as compared to the control group. Additionally, the Authors observed a reduction in the loss of the muscular mass, occurrence of complications, such as postoperative wound infections, and shorter hospitalization (6).

Hausel et al. in 2005 presented study results performed in patients subject to laparo-

scopic cholecystectomy. They demonstrated that the metabolic preparation by means of oral bicarbonate solutions significantly reduces nausea and vomiting after the initiation of anesthesia (12).

Micic et al. compared the intensification of insulin-resistance in patients subject to laparoscopic and open cholecystectomy. The Authors observed increased insulin-resistance in both groups between day 0 and 3. However, a statistically significant difference between both groups was noted on the third day after surgery. Insulin resistance occurred less often in case of patients subject to laparoscopic cholecystectomy, which is evidence of the correlation between the extent and intensity of the injury. On the seventh day after surgery insulin-resistance levels returned to normal, considering both cholecystectomy methods (13).

Our study results confirmed the occurrence of postoperative insulin resistance in patients with nodular goiters subject to thyroidectomy. We observed a statistically significant increase in the insulin level and HOMA-IR ratio, 24 hours after surgery. A statistically significant increase of both mentioned parameters was also observed on the seventh day after thyroidectomy.

In 2001 the ERAS (Enhanced Recovery After Surgery) team was established, whose role is to determine, on the basis of available medical data, novel rules facilitating and speeding recovery in patients subject to surgical intervention. The ERAS group promotes changes considering guidelines for food intake. The effect of night fasting is very unfavorable for the organism exposed to perioperative stress. Several hours of interruption in the supply of food contributes to the complete consumption of hepatic glycogen, increasing stress and anxiety before the surgical procedure. Similarly to the surgical procedure, it induces the activation of the hypothalamus-pituitary-adrenal axis intensifying the release of stress hormones, such as catecholamines, cortisol, and the growth hormone. The above-mentioned mechanism predisposes to the occurrence and intensification of postoperative insulin-resistance (5, 14). Based on studies elaborated by Soreide et al. (15), Ljungqvist et al. (16), and Spies et al. (17) it is believed to be acceptable that the patient receives fluids, such as water, coffee, tea or highly energetic

carbohydrate solutions, and solid food, up to six hours before the scheduled surgery. Elimination of the effect of overnight fasting from the subjective point of view of the patient seems to be a significant benefit to the supply of oral glucose solutions.

The phenomenon of insulin resistance may be a consequence of any condition in which the patient is exposed to chronic stress. This is particularly important in situations where the patient is subject to severe injuries including surgical trauma. Literature data clearly indicates the increase of insulin-resistance, as a factor directly correlating with the occurrence of postoperative complications, and prolonged recovery time. Currently, it is believed that postoperative insulin resistance, apart from

the extent of the procedure, and perioperative blood loss is one of the three main factors determining the duration of the procedure (18).

CONCLUSIONS

Proper metabolic preparation of patients before elective surgery may significantly reduce the risk of postoperative insulin-resistance. In case of patients prepared for total thyroidectomy by means of oral carbohydrate solutions we observed a reduction in the number of complications following anesthesia, and overcoming the effect of nocturnal fasting improved the comfort of patients subject to elective surgical procedures.

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