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Criteria of Glycemic Control in Type 2 Diabetes Mellitus

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The paper presents the basic criteria for glycemic control in type 2 diabetes mellitus, the data on the relationship between postprandial glycemia and the development of the late vascular complications, and methods for evaluating the glycemic index of foodstuffs and dishes in order to optimize the diets and improve the efficiency of therapeutic measures in this disease.

Key Words: *continuous monitoring of glucose; pre- and postprandial glycemia; glycemic control; type 2 diabetes mellitus*

Chronic hyperglycemia is responsible for the development and progress of vascular complications leading to early disability of patients with type 2 diabetes mellitus (DM2). Preprandial glycemia and glycated hemoglobin (HbA1c) have been regarded as the main indicators of carbohydrate metabolism compensation in DM2 up to recent time. However, recent studies show that postprandial glycemia (PPG) is also essential for the optimal glycemic control [2,9]. It is associated with high risk of microangiopathy, thickening of the carotid artery intima-media, reduction of myocardial blood volume and of myocardial blood flow [8]. A close relationship between PPG and the development of oxidative stress and endothelial dysfunction has been demonstrated [2,7]; variability of glycemia levels can lead to more serious consequences than stable high glycemia.

The key tests for glycemic control in DM2 are measurements of glucose after overnight fasting and HbA1c level (an integral index reflecting the degree of carbohydrate metabolism compensation over recent 3 months), and also of PPG level, which should be monitored to attain the recommended HbA1c values [2,4]. The parameters of correspondence of the target HbA1c levels to the target plasma glucose pre- and postprandial levels are presented in Table 1 [4].

Today biochemical analyzers and portable express analysis systems are used to monitor HbA1c, fasting glycemia, and PPG in DM2 patients. Analytical methods are developed and used for measurements of HbA1c: high- and low-pressure cation exchange chromatography, ion exchange chromatography, affinity chromatography; electrophoretic method and electrofocussing; colorimetry with thiobarbituric acid; immunochemical methods. Individual target values of glycemia can be attained and the development of micro- and macrovascular complications in DM2 patients can be prevented only by regular monitoring HbA1c, pre- and postprandial glycemia.

New methods for evaluating carbohydrate metabolism disorders and for diabetes monitoring, based on the use of devices for continuous glucose monitoring, have been developed in recent years [3,6]. Real-time continuous monitoring of glucose concentrations by means of system consisting of a sensor fixed in the abdominal subcutaneous fat, device for data storage, and a monitor present a complete glycemic profile of the patient within several days and a graphic representation of the results and estimation of the number of measurements within the range of target values.

The results of numerous studies indicate that glycemic effects of carbohydrate-containing foodstuffs depend on the quantity and quality of carbohydrates, protein, lipids, nutrient fibrils, and on the presence of antinutrients (saponins, lectins, tanins, α-glycosidase inhibitors, *etc.*) in the food, methods of technological processing of foodstuffs, *etc.* [1,5]. It is impossible to evaluate the PPG effect of foodstuffs on the basis of just their chemical composition. The postprandial glycemic reaction is individual for each carbohydrate-

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containing foodstuff and should be studied experimentally. The glycemic index (GI) of foodstuff is used for quantitative evaluation of PPG after consumption of any carbohydrate-containing foodstuff. This index is used to compare foodstuffs containing equal levels of carbohydrates and classify them with consideration for their postprandial glycemic effects [1,5]. Foodstuffs with low GI (legumes, some cereals, and majority of fruits and vegetables) contain complex and simple carbohydrates, which are slower cleaved and absorbed. Consumption of these carbohydrates leads to a lesser glycemic effect.

Plasma glucose level for GI estimation is measured after 14-h fasting and 15, 30, 45, 60, 90, 120, and 180 min after test foodstuff or test meals. The area under the glycemic curve presenting fasting glycemia is calculated by the geometrical method according to the formulae:

$(A+B+C+D/2)\times t+[(D+E)\times T]/2+[(E+F)\times T/2]$,

if the latest glycemia level (120 min) is higher than the preprandial one,

$(A+B+C+D/2)\times t+[(D+E)\times T]/2+[(E^2\times T)/2(E+F)]$,

if the latest glycemia level (120 min) is lower than the preprandial one. A, B, C, D, E, and F are blood glucose increment values, that is, the difference between its preprandial level and glucose concentrations during the studied periods (t, T).

The foodstuff GI is the proportion between the areas under glycemic curve plotted after the test foodstuff consumption, and under the curve plotted after wheat bread consumption multiplied by 100. Wheat bread is used as the reference meals, its dose corresponding to 50 g carbohydrates.

Alimentary glycemic load (GL) determined by carbohydrate content in the foodstuff and the mean GI, is as a rule used for common estimation of glycemia values and evaluation of need in insulin.

The GI and GN are used to evaluate glycemic effect in consumption of mixed food. The use of such a parameter as GI in clinical practice offers more advantages for diabetes control; in addition to estimation of total carbohydrates, it shows the PPG fluctuations and promotes reduction of cardiovascular risk factors [5].

TABLE 1. Target HbA1c Level, Corresponding to Target Pre- and Postprandial Plasma Glucose Levels*

HbA1c, %	Glucose level, mmol/liter	
	after fasting/before meals	2 h after meals
<6.5	<6.5	<8.0
<7.0	<7.0	<9.0
<7.5	<7.5	<10.0
<8.0	<8.0	<11.0

Note. *Target values not fit for children, adolescents, and pregnant women.

Hence, due to introduction of innovation technologies for carbohydrate metabolism evaluation in clinical practice, the optimal glycemic control in DM2 patients reduces the risk of late vascular complications, improves the efficiency of therapeutic measures, and improves the patient's quality of life.

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