The Role of Specialized Food for Enteral Nutrition in the Treatment of Diabetes Type 2

I.Yu.Semenchenko, H.H.Sharafetdinov, O.A. Plotnikova, Lapik I.A., Alekseeva R.I., Sentsova T.B.

ABSTRACT

Objective: To investigate the effectiveness of personalized diet therapy with the inclusion of a specialized food for enteral nutrition (EN) on the anthropometric and body composition, carbohydrate and lipid metabolism in patients with type 2 diabetes.

Patients and methods. The study included 231 patients with confirmed diagnosis of type 2 diabetes under subcompensation carbohydrate metabolism. In all patients, conducted a comprehensive survey of the patients included in the study with the use of multi-level evaluation of disorders of the nutritional status and the risk of nutrition-related diseases "Nutritest SP-3." Randomized patients were divided into two groups: group A - patients receive personalized diet therapy with the inclusion of a specialized food for EA, and group B - patients received a low-calorie version of the standard diet.

Results. Studies have shown that personalization of diet inclusion of specialized food for EA not only to optimize the protein, carbohydrate and fatty acid composition of the diet, but also contributes to the effective correction of the broken indicators of nutritional status in patients with type 2 diabetes and obesity I-III degree (weight loss, BMI, WC, ON, the content of body fat and visceral fat area, improved glycemic control and lipid profile parameters).

Conclusion. Personalization dietary diet using specialized food for EA modified protein, fat and carbohydrate composition contributes to effective correction of metabolic abnormalities in patients with type 2 diabetes with obesity I-III degree.

Keywords: obesity, personalized diet therapy, type 2 diabetes, enteral feeding.

INTRODUCTION

Diabetes mellitus (DM) is currently a global psychological, social and economic problem that is defined by the soaring incidence, high frequency, severity and progression of vascular complications leading to early morbidity and high mortality.

According to the International Diabetes Federation [1], now in the world there are 366 million diabetic patients aged 20-79 years, of which 85-95% are patients with type 2 diabetes. It is predicted that by 2030 the total number of patients with diabetes will increase by 1.5 times and

reached 552 million, mainly due to patients with type 2 diabetes. According to the UN and WHO, from diabetes every 7 seconds in 1 patient dies every 10 seconds 12 sick person; die each year about 4.6 million patients with diabetes [2] The high rates of prevalence and incidence of vascular complications, such as myocardial infarction, stroke, gangrene of the lower extremities, nephropathy, etc., determine the need for the development and introduction into clinical practice of high-tech diagnostic methods, treatment and prevention of diabetes.

In the development and progression of vascular complications, leading to significant economic costs, a key role is played by chronic hyperglycemia [3, 4]. Chronic hyperglycemia participates in the pathogenesis of macro-and microvascular complications, both directly and indirectly by initiating several biochemical processes, which include oxidative stress, excessive formation of glycosylation end products, increased synthesis of diacylglycerol and others [5]. In order to achieve optimal glycemic control and reducing the risk of vascular complications, along with basal glycemia and glycated hemoglobin plays an important role postprandial glycemia [6, 7], associated with an increased risk of retinopathy, increasing intima-media thickness of the carotid artery, a decrease in myocardial blood volume and myocardial flow. In this connection, correction and monitoring indicators of glycemic control is necessary from the viewpoint of prevention of macro-microvascular complications in patients with diabetes.

As you know, one of the objectives of diet therapy in type 2 diabetes is to ensure adequate nutritional support of patients, aimed at correcting metabolic disorders such as basal and postprandial hyperglycemia, hyperinsulinemia, dyslipidemia, etc. To this end, traditionally used specialized food products for enteral nutrition (EN), characterized by a modified carbohydrate and fat composition of including a complex of vitamins, minerals and trace elements. In numerous clinical studies have shown the advantage of specialized products for EPO compared with standard mixtures to achieve optimal glycemic control and improving blood lipid profile in patients with diabetes [8-10].

Results of a meta-analysis of 23 studies [10] have shown that the use of specialized mixes for CE leads to a significant reduction of postprandial hyperglycemia, smaller peak levels of glucose in the blood, decrease in the area under the glycemic curve, significant reduction in insulin requirements. Optimization of glycemic control in diabetic patients is closely related to the modification of the carbohydrate composition of EPO of specialized products, including those with the exception of mono-and disaccharides and their replacement on the maltodextrins with a low degree of hydrolysis, the inclusion of sweeteners, high-fiber, etc.

Company Nutricia Medical Advanced Nutrition («NVNutricia», The Netherlands) has developed a specialized food for EP "Nutrizon EDVANST diazonium" (certificate of state

registration number 77.99.19.4.U.4238.5.09 from 05/05/2009), intended for patients with diabetes as an additional source of energy and micronutrients. This product contains in its structure soy protein, fructose, modified starch, soluble mixture (80%) and insoluble (20%) dietary fiber composition has a fat-modified (69% mononenasaschennyh fatty acids) with an optimal ratio of polyunsaturated fatty acids, n: 6 / n: 3.
The purpose of this research was to study the effectiveness of personalized diet therapy with the inclusion of a specialized food for EA anthropometric indicators and indicators of body composition, carbohydrate and lipid metabolism in patients with type 2 diabetes.

PATIENTS AND METHODS

The study included 231 patients with confirmed diagnosis of type 2 diabetes, 55% of women and 45% men, aged 46,1 ± 0,8 years, under subcompensation carbohydrate metabolism without insulinopotrebnosti repositories on a standard diet therapy with concomitant diseases that do not require intensive treatment. Mean level of glycosylated hemoglobin (HbA1c,%) was 7,4 ± 1,1%. To assess the degree of compensation of type 2 diabetes using the criteria proposed by the experts of the European Group on Policy Diabetes International Diabetes Federation (IDF, 1999) in accordance with the "algorithm specialized medical care to patients with diabetes" (2011).
Exclusion criteria were insulin, nephropathy on proteinuria, chronic renal failure, use of nonsteroidal anti-inflammatory drugs.

All patients were overweight and obesity degree I-III: BMI group average was 37,9 ± 1,87 kg / m ².

Of comorbidities most frequently detected digestive diseases - chronic calculous cholecystitis (at 9.1%), chronic cholecystitis nekalkulezny (36%), postcholecystectomical syndrome (at 12.1%), as well as related kidney disease - urolithiasis (y 6%) and chronic pyelonephritis (24%), chronic pulmonary disease (COPD, asthma) were detected in 9.9% of patients with hypertension - 30.2%.
Patients with type 2 diabetes included in the study were randomly divided into two groups of the same type: the main group (n = 128 pers.) And a comparison group (n = 103 pers.) And comparative analysis as presented in Table 1.

In the main group, the number of obese patients I, II and III century. was 58, 34 and 36 in control group - 38, 34 and 31 resp.

Patients of the main group (group A, n = 128) received a personalized version of the diet with the inclusion of a specialized diet food for EA based on the calculation of individual energy

needs using the indirect calorimetry using a respiratory calorimeter portable «Fitmate» (firm COSMED, Italy).

Patients comparison group (group B, n = 103) was obtained in a low calorie diet version ACI (according to the order of Ministry of Health of the Russian Federation of 05.08.2003 № 330 "On measures to improve nutritional care in health care institutions of the Russian Federation" and the order of the Ministry of Health of Russia 21.06 .2013, the number 395n "On approval of rules of Clinical Nutrition").
In all patients, conducted a comprehensive survey of the patients included in the study with the use of multi-level evaluation of disorders of the nutritional status and the risk of nutrition-related diseases "Nutritest SP-3." All patients were examined for fasting glycemia and 2 hours after a meal, as well as the level of glycated hemoglobin (HbA1c). Using standard methods of anthropometric studies measured height (cm), body weight (kg), waist circumference (cm), hip circumference (OB, cm), and calculated body mass index (BMI, kg/m2) and a ratio of / ON.

Assessment of body composition (fat, lean and active cell mass, extra-and intracellular fluid) was performed using the bioimpedance by standard technique using bioimpedance analyzer «Inbody 720" company Biospace Technology (Korea).

Study of biochemical parameters in serum (determination of total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides (TG), urea, creatinine, uric acid, alanine-activity (ALT) and aspartate aminotransferase (AST) was performed on the analyzer firm «Konelab 30i» (Finland).

Analysis was performed using the software package SPSS 17.0 for Windows. Results are presented as mean values and standard error of the mean value (M ± m). Evaluation of significance of differences of averages performed using Student t-test. The significance level was considered significant at $p < 0.05$.

RESULTS AND DISCUSSION

To achieve the objectives evaluated the clinical efficacy and tolerability personalized diet to include specialized product for EPO in patients with type 2 diabetes. Randomized, parallel, controlled study was conducted at two similar in age, BMI, comorbidity groups of patients.

Portability personalized diet with the inclusion of a specialized product for EPO was good, with no signs of intolerance to the product were observed.

All patients in the diet therapy, regardless of the variant used diet, there was a positive dynamics of clinical symptoms: decreased complaints of shortness of breath, headaches, dizziness, flashing "flies" before the eyes, general weakness, increased exercise tolerance.

Dynamics of anthropometric parameters in patients with type 2 diabetes with obesity I-III degree in the treatment process is presented in Table 2.

Of Table 2 shows that both groups of patients observations decreased body weight, BMI, WC and OB, relationship FROM / ON, while a marked positive dynamics studied anthropometric indices in patients of the main group. Thus, in the process of incorporating a personalized diet therapy specialized product for EPO (group A) showed a significant decrease in OT, OB and index FROM / ABOUT above baseline values as compared to the comparison group (group B).

Dynamics of body composition in patients with type 2 diabetes with obesity I-III degree in the treatment process is presented in Table 3.

From the results presented in Table 3 shows that both groups of patients observations regardless of the degree of obesity there was a significant reduction of body fat mass, the degree of reduction in fat mass was more pronounced in the main group of patients (group A) received a personalized ration with the inclusion of a specialized food for EA. No significant differences in the dynamics of body fat content between treatment groups were observed. Win skeletal muscle mass and lean body mass in patients of group A with I-III degree of obesity in 2 weeks tended to a slight decrease in patients of group B with I-III degree of obesity, a significant decrease of these parameters from baseline. Visceral fat area decreased to a greater extent in patients of group A compared with that in patients of group B. The results show the positive impact of a personalized diet to include specialized food for EPO on indicators of body composition in patients with type 2 diabetes with obesity I-III degree.

Dynamics of basal glucose and lipid metabolism markers in patients with type 2 diabetes with obesity I-III degree in the treatment process is presented in Table 4, which implies that both groups of patients observations regardless of the degree of obesity a significant decrease in fasting glucose serum, but the degree of reduction of basal glycaemia was more pronounced in the basic group of patients (Group A) as compared with the comparison group (group B). The findings suggest that personalized nutritional therapy with the inclusion of a specialized food for EPO This improved glycemic control in patients with type 2 diabetes with obesity I-III degree. To a certain extent this may be due to characteristics of the product composition comprising slowly absorbed carbohydrate, dietary fiber and monounsaturated fatty acids (MUFA), and may also be due to the improved insulin sensitivity and functional activity of β-cells of the pancreas, while the more pronounced reduce body fat and visceral fat area in patients with type 2 diabetes with concomitant obesity on background personalized diet therapy.

Comparative evaluation of markers of lipid metabolism in patients enrolled in the study (Table 4) showed that obese patients I Art. against the background of a personalized diet therapy with the inclusion of a specialized product for EPO (group A) showed positive dynamics of the lipid profile: reduction of total cholesterol, LDL cholesterol and triglycerides in the blood serum averaged 8.2%, 9.4% and 12.9% relative baseline values ($p < 0.01$, $p < 0.001$ and $p < 0.001$, respectively).. Content of HDL cholesterol in patients of group A increased on average by 22.2% ($p < 0.001$). Dynamics of lipid profile parameters in patients of group B with obesity I Art. was less pronounced and not statistically significant.

The content of total cholesterol, LDL cholesterol and triglycerides in the blood serum of patients with type 2 diabetes with obesity II Art. Group A patients decreased on average by 7.2%, 13.5% and 16.3% relative to baseline values ($p < 0.001$, $p < 0.01$ and $p < 0.001$, respectively). while increased HDL-C on average 28.6% ($p < 0.001$). Dynamics of markers of lipid metabolism in obese patients with Article II. (Group B) was less pronounced and not statistically significant (Table 4).

In patients with type 2 diabetes with obesity III century. against the background of a personalized diet therapy with the inclusion of a specialized product for EPO (group A), a significant decrease in total cholesterol, LDL cholesterol and triglycerides in the blood serum of 6.1%, 7.8% and 8.7% relative to baseline values ($p < 0.001$, $p < 0.01$ and $p < 0.001$, respectively).. HDL cholesterol levels in patients of group A increased on average by 10% ($p < 0.001$). Dynamics of lipid metabolism in obese patients with Stage III. (Group B) was less pronounced and not statistically significant (Table 4).

Thus, the comparative analysis of lipid profile in patients with type 2 diabetes with obesity degree I-III evidence of the positive impact of diet inclusion personalized specialized product for EPO on markers of lipid metabolism and risk factors for cardiovascular complications. The data obtained allow us to conclude that the inclusion of a personalized diet specialized product for EPO MUFA-rich, with the modification of protein and carbohydrate composition, enhances the effectiveness of diet therapy in the correction of lipid metabolism and risk factors for cardiovascular complications in patients with type 2 diabetes with a concomitant obesity.

Significant changes in blood biochemical parameters (urea, creatinine, uric acid, ALT and AST) in both groups on background diet were observed.

Thus, the personalization of dietary diet with nutritional support as specialized food for EA modified protein, fat and carbohydrate composition contributes to effective correction of disturbed eating and indicators of metabolic status of patients with type 2 diabetes with obesity I-

III degree in order to reduce the risk of cardiovascular complications and improve quality of life for these patients.

REFERENCES

1. Ametov A.S., Melnik A.V. Upravlenie saharnym diabetom: rol' postprandial'noj giperglikemii i vozmozhnosti ee korrekcii g [Diabetes Managin: the role of postprandial hyperglycemia and its correction]. J Breast Cancer, 2007, №15, p. 2053-2058.

2. Balabolkin M.I., Klebanov E.M., Kreminskaya V.M. Lechenie saharnogo diabeta i ego oslozhnenij [Treatment of diabetes and its complications]: Uchebno-metodicheskoe posobie [Study guide]. Moscow: OAO «Izdatel'stvo «Medicina», 2005.

3. Dedov I.I. Saharnyj diabet – opasnejshij vyzov mirovomu soobshhestvu [Diabetes - the most dangerous challenge to the world community]. Vestnik Rossijskoj akademii medicinskih nauk [Bulletin of the Russian Academy of Medical Sciences], 2012, № 1, p. 7-13.

4. Sharafetdinov H.H., Meshcheriakova V.A., Plotnikov O.A. Metodologija primenenija pishhevyh smesej, ispol'zuemyh v jenteral'nom pitanii, v dietoterapii bol'nyh saharnym diabetom 2 tipa [Methodology of nutritional mixtures used in enteral nutrition, diet therapy of patients with type 2 diabetes]. Voprosy pitanija [Nutrition], 2005, №74, p. 17-22.

5. Coulston A.M. Enteral nutrition in the patients with diabetes mellitus. Curr.Opin.Clin.Nutr.Metab.Care. 2000; 3: 11-15.

6. Elia M., Ceriello A., Laube H. et al. Enteral nutritional support and use of diabetes-specific formulas for patients with diabetes. Diabetes Care 2005; 28: 2267-2279.

7. IDF Diabetes Atlas, 5th ed., 2011.

8. Ohkubo Y., Kishikawa H., Araki E. et al. Intensive insulin therapy prevents the progression of diabetic microvascular complications in Japanese patients with non-insulin-dependent diabetes mellitus: a randomized prospective 6-year study. Diabetes Res.Clin.Pract. 1995; 28: 103-117.

9. Shiraiwa T., Kaneto H., Miyatsuka T. et al. Postprandial hyperglycemia is an important predictor of the incidence of diabetic microangiopathy in Japanese type 2 diabetic patients Biochem.Biophys.Res.Commun. 2005; 336: 339-345.

10. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with traditional treatment and risk of complications in patients with type 2 diabetes. Lancet 1998; 352: 837-853.

Data for correspondence:

Sharafetdinov Haider Hamzyarovich, MD, head of metabolic diseases FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel. 8 (499) 794-35-16.

Semenchenko Irina Yrievna, endocrinologist offices metabolic diseases FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel.8 (499) 613-11-89

Plotnikova Oksana Alexandrovna, PhD, senior researcher of metabolic diseases FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel.8 (499) 613-11-95

Lapik Irina Alexandrovna, Junior Researcher FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel.8 (499) 613-11-89

Alekseeva Ravilya Ismailovna, PhD, researcher at the Department of metabolic diseases FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel. 8 (499) 613-11-89

Sentsova Tatiana Borisovna , MD, Professor, Head of the Laboratory of Clinical Biochemistry, Immunology and Allergy FGBU "NRI", 115446 Moscow, Kashirskoye, 21, Tel.8 (499) 613-11-89

Index	Group	
	Summary	Comparisons
Age, years	44,1±2,6	49,1±2,9
Duration of disease, years	7,5±2,1	7,0 ±1,9
Body weight, kg	104,9±3,5	103,7±4,1
BMI, kg / m ²	37,4±0,9	37,3±1,2
The average level of glycated hemoglobin HbA1c,%	7,4±1,0	7,4±1,3

Table 2

Dynamics of anthropometric parameters in patients with type 2 diabetes with obesity I-III degree during treatment (M ± m).

Index	Group	I obesity degree		Obesity II degree		III degree obesity	
		1	2	1	2	1	2
Body weight, kg	A	98,2±3,4	92,6±3,2***	105,6±3,4	99,4±3,2***	110,9±3,4	105,8±3,2***
	B	96,8±3,9	94,2±3,1	104,6±5,0	102,2±2,9	109,7±3,6	107,1±4,0
BMI, kg/m^2	A	33,7±0,9	31,7±0,6***	36,7±0,86	34,7±0,65***	41,9±1,4	38,8±2,1***
	B	34,2±0,6	33,7±1,5	36,2±0,73	35,1±1,5	41,6±1,7	39,7±2,5
Hip circumference, cm	A	97,9±2,8	94,2±2,3***	116,8±2,8	113,2±2,3***	117,4±2,8	114,7±2,3***
	B	93,3±4,0	92,1±2,9	113,6±3,2	112,1±2,9	119,3±3,2	117,4±2,9
Waist circumference, cm	A	88,6±1,8	84,7±1,8	109,2±1,8	104,7±1,8*	112,7±1,8	109,2±1,8*
	B	84,8±1,8	83,6±2,3	107,5±1,8	105,4±1,9	114,9±1,8	111,2±2,1
OT/OB	A	0,9±0,02	0,88±0,03*	0,93±0,06	0,91±0,05*	0,96±0,07	0,94±0,06*
	B	0,91±0,02	0,90±0,01	0,95±0,08	0,94±0,06	0,96±0,06	0,95±0,04

Note: hereinafter: 1 - before treatment; 2 - through 2 weeks after treatment; p - reliability of differences from baseline * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3

The body composition indicators in patients with type 2 diabetes with obesity I-III in the treatment power (M ± m).

Index	Group	I obesity degree		Obesity II degree		III degree obesity	
		1	2	1	2	1	2
Fat mass, kg	A	41,1±0,9	38,7±0,7**	49,1±0,6	45,8±0,5*	74,1±1,4	67,6±1,3*
	B	44,2±0,9	42,9±0,6*	49,7±1,0	47,3±0,5*	78,3±1,8	75,8±1,2*
Skeletal muscle weight, kg	A	31,2±0,5	30,6 ±0,8	34,2±0,8	34,3±0,6	38,0±0,6	37,5±0,8
	B	34,8±0,9	32,2 ±0,6*	36,8±0,7	34,6±0,7*	38,1±0,6	36,8±0,8*
Lean mass, kg	A	56,4±1,4	56,3±1,3	58,3±1,5	58,8±1,6	58,1±0,6	57,0±0,8
	B	54,7±1,2	52,1±0,9*	58,6±1,5	56,3±1,3*	58,2±0,7	55,8±0,6*
Visceral fat area, cm^2	A	169,8±5,1	162,2±2,1*	210,4±3,6	197,9±2,3*	310,3±7,2	289,7±5,4*
	B	179,5±4,8	174,1 ±2,6	206,4±1,8	200,6±1,8	309,5±7,2	295,7±5,0*

Table 4

Dynamics of basal glucose and lipid metabolism markers in patients with type 2 diabetes with obesity I-III degree during treatment (M ± m).

Index	Group	I obesity degree		Obesity II degree		III degree obesity	
		1	2	1	2	1	2
Glucose, mmol / l	A	7,4±3,2	6,2±1,8 *	8,3±2,4	6,8±2,7 *	9,7±2,9	7,9±2,1 *
	B	7,5±3,2	6,5±1,6 *	8,2±2,4	7,0±2,3 *	9,5±2,8	8,0±1,9 *
Total cholesterol, mmol / L	A	6,1 ±0,6	5,6±0,6***	6,9±0,2	6,4±0,6***	8,2±0,4	7,7±0,6***
	B	6,2±0,5	5,9±0,6	6,8±0,4	6,7±0,3	7,9±0,5	7,7±0,4
TG, mmol / L	A	3,1±0,4	2,7±0,4**	4,3±0,8	3,6±0,4**	4,6±0,2	4,2±0,4**
	B	2,5±0,1	2,4±0,1	4,3±0,2	3,9±0,1	4,6±0,3	4,4±0,1
HDL-C, mmol / L	A	0,9±0,04	1,1±0,04***	0,7±0,06	0,9±0,04***	1,0±0,07	1,1±0,04***
	B	0,9±0,05	1,0±0,05	0,8±0,07	0,9±0,05	0,9±0,05	0,9±0,05
LDL-C, mmol / L	A	3,2±0,2	2,9±0,2***	3,7±0,2	3,2±0,2***	5,1±0,08	4,7±0,2***
	B	3,1±0,2	3,0±0,2	4,3±0,3	3,5±0,2	4,9±0,3	4,7±0,2