COEXISTENCE OF CARDIOVASCULAR DISEASES IN PATIENTS WITH TYPE 2 DIABETES

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Aim — to identify the most significant risk factors that affect the occurrence of cardiovascular complications in patients with type 2 diabetes and to create the supplement for the risk assessment of cardiovascular complications in patients with type 2 diabetes.

Methods of research. The object of the study is adult patients with type 2 diabetes mellitus (n = 60). For the development and analysis of the material, a statistical method is used, a modeling method of constructing the classification trees.

Discussion and results. Statistically significant risk factors for cardiovascular complications in type 2 diabetes are a high body mass index, the presence of insulin therapy, the duration of the disease, a high maximum level of systolic blood pressure, high concentrations of LDL, markers of cell damage, and some hemodynamic parameters of myocardial function. A multidimensional model of the risk of complications was developed, which served as an algorithm for the created computer program, their early prognosis and timely carrying out of preventive measures.

Keywords: type 2 diabetes mellitus, cardiovascular complications, risk factors, modelling

Diabetes mellitus (DM) is one of the most significant medical and social problems of modern society. By 2030, WHO experts predict an increase in the number of people with diabetes to 366 million people [1]. Russia ranks 5th in the world and first in Europe in terms of the number of patients with diabetes [2]. As of January 2015, 4.1 million patients with diabetes were officially registered in the country, which is 2.8% of the population of the Russian Federation, of which 3.7 million patients had type 2 diabetes. In the Orenburg region, per 100 thousand population in 2014 there were 216.52 people with type 2 diabetes, which, according to the State Register, corresponds to the high prevalence of the disease. Among the causes of mortality and disability in patients with diabetes 2 types, the leading position is occupied by cardiovascular pathology. Heart failure, cerebrovascular accidents and myocardial infarction are the cause of death in 50.7% of people. The economic damage associated with diabetes is estimated at 12.5 billion US dollars. Of this amount, 91% is spent on treating diabetes complications.

Currently, Russian healthcare institutions, including in the Orenburg region, are taking measures to create, develop and implement modern information technologies and medical information systems (MIS). Their goal is to simplify the work of specialized specialists, create additional comfort in the form of reducing the amount of work with paper media, the ability to obtain information in real time, that is, to optimize the activities of medical services.

To identify the most significant risk factors influencing the occurrence of cardiovascular complications in patients with type 2 diabetes mellitus, and to create an application for assessing the risk of cardiovascular complications in patients with type 2 diabetes mellitus.

A retrospective study of 60 patients was conducted. The presence of myocardial infarction was determined according to the criteria of the Russian Society of Cardiology [4]. The diagnosis of diabetes was established according to the criteria of the WHO Expert Committee [5]. As part of this work, all study subjects were divided into two groups: patients with type 2 diabetes mellitus and cardiovascular complications (CVC) - the study group (n=30) and without them - the comparison group (n=30), selected using the copy-pair method.

RESEARCH RESULTS AND DISCUSSION:

The average age of patients in the main group was 53.0 [49.0; 58.0] years, which is significantly lower compared to the control group 59.0 [53.0; 68.0] years of the year ($p<0.05$). The study of anthropometric parameters of patients revealed a significant increase in body mass index among patients in the main group ($p<0.001$). An assessment of the maximum systolic blood pressure (BP) values of the sample participants revealed a slight increase in the mean systolic blood pressure among patients with cardiovascular complications ($p<0.001$). The duration of diabetes mellitus was significantly higher in patients of the main group; the presence of insulin therapy also had an impact on the development of diabetes complications ($p < 0.001$). The average value of the concentration of total cholesterol in the blood of patients revealed hypercholesterolemia among the subjects in the control group; in the comparison group, the average value of total cholesterol was within the normal range ($p = 0.04$). The average value of fasting blood glucose concentration in representatives of the main group was significantly higher than the control group ($p = 0.007$). Among other biochemical indicators, a significant increase in indicators of the main group was revealed: LDL, glycosylated hemoglobin, concentrations of markers of cellular damage AST, ALT, CPK, troponin-T ($p<0.001$). A reliable relationship between clinical, laboratory and morphological parameters is presented in Table 1.

To clarify the most significant risk factors and their interaction, a mathematical model of forming a risk group for cardiovascular complications of diabetes was built (Figure 1). The constructed model has sufficient forecasting power. Taking into account the 80

patients who participated in the survey, classification errors in the training set amounted to 3 cases (3.8%), that is, 96.2% of respondents were correctly classified, which corresponds to the good predictive value of the model. Evaluation model risk of developing cardiovascular complications includes 11 nodes, of which 7 are parent nodes, and 4 are terminal nodes that answer the classification question, namely: what risk - high or low - does the object of classification have.

Branching of parent nodes occurs based on the rules of classification trees. If the rule is satisfied, then the transition to the left node from the parent is always carried out. If not, then to the right. Thus, the first classification rule is an LDL value less than or equal to 4.0 mmol/l. If the rule was met, the subjects were assigned to the left node, which determined only low risk. If the rule was not satisfied, they were assigned to the right node. Further division took place on the basis of the division rule according to the concentration of CPK, less than or equal to 64 units/l, the level of HbAc, less than or equal to 6%, etc. Based on the above mathematical model, the development of the DiabetRisk application, which has no analogues in Russia, is underway for assessing the risk of developing cardiovascular complications in patients with type 2 diabetes mellitus.

CONCLUSIONS Analysis of risk factors that led to complications of diabetes mellitus identified the leading ones, such as BMI, the presence of insulin therapy, duration of diabetes, maximum level of systolic blood pressure, LDL concentration, markers of cellular damage, and some hemodynamic indicators of myocardial function. Based on the studied factors risk factors affecting the occurrence of cardiovascular complications in patients with diabetes mellitus, a model was built for forming a group of patients at risk for cardiovascular complications including all statistically significant risk factors. The constructed model serves as an algorithm for selecting tested patients with diabetes mellitus to assess increased the risk of vascular complications for the purpose of subsequent differentiation and optimization of preventive measures. The application being developed, which is based on the above-mentioned model, will reduce the incidence of complications associated with diabetes.

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