Creating a neural network model based on glycemic variability indices to predict the degree of compensation for type 1 diabetes

The study included 80 patients with type 1 diabetes mellitus, aged 8-18 years (12.6 ± 2.8), receiving insulin therapy in a pump mode with the possibility of continuous monitoring of glycemia. 70 patients were randomly selected for inclusion in the training sample, 10 patients made up a test one.

The subjects transmitted data on self-monitoring, insulin therapy and diet to the doctor using various programs for continuous monitoring of glycemia. All patients underwent glycated hemoglobin (HbA1c) analysis.

To conduct a comparative analysis of glycated hemoglobin (HbA1c) and glycemic variability indexes to predict the degree of compensation for the diabetes mellitus type 1

Materials and methods

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Results

The regression neural network model was built in the type R statistical computing environment using the Neuralnet. The structure of the model was chosen by comparing more than 20 thousand test models. Statistical analysis was performed using the SPSS 23.0 software (IBM SPSS Statistics, USA).

The optimal model was based on a multilayer perceptron with three hidden layers and the number of neurons in each layer. The constructed model showed a very high value of the coefficient of determination $R^2 = 0.987$, which indicates a high confidence in predicting the level of HbA1c. When creating a traditional model based on multiple regression, the coefficient of determination was $R^2 = 0.254$, which indicates a low prediction accuracy of the HbA1c level and a higher residual error.

The neural network makes it possible to assess the degree of compensation for the disease and provide a personalized approach in treating these patients

Materials and methods

As independent parameters for predicting the level of HbA1c, glycemic variability indices calculated using the EasyGV calculator were chosen:
- SD - standard deviation, mmol/l
- MAGE - average amplitude of vibrations, mmol/l
- CONGA - index of long-term increase in glycemia, mmol/l
- J-index - quality control index
- LI - lability index, predictor of hypoglycemia
- LBGI - Hypoglycemia risk index
- HBGI - Hyperglycemia risk index
- ADRR - medium risk index
- MValue - quality control, mmol/l
- MAG - glycemic change rate, mmol/l/hour

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