Diabetes Overview Based on Artificial Intelligence

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ABSTRACT

The review presents the possibilities of using artificial intelligence to study the mechanisms of development of diabetes mellitus (DM) and create new technologies for its prevention, diabetes symptoms, monitoring and treatment.

Keywords: Diabetes mellitus, symptoms, artificial intelligence, machine learning, data mining.

Introduction

In recent years, a huge array of molecular data has been accumulated that reveal the pathogenetic mechanisms of the development of diabetes mellitus and its complications. Intellectual analysis of data and texts of scientific publications (data mining and text mining) opens up new possibilities for processing this information. Analysis of molecular genetic networks makes it possible to identify molecular interactions that are important for the development of diabetes and its complications, as well as to identify new targeted molecules. Based on the analysis of big data and machine learning, new platforms have been created for the prognosis and screening of diabetes mellitus, diabetic retinopathy, chronic kidney disease, and cardiovascular complications. Machine learning algorithms are used for personalized glucose prediction, closed-loop insulin delivery systems, and decision support systems for lifestyle modification and diabetes treatment. It seems promising to use intelligent systems for the analysis of large databases, registers, research in real clinical practice.

Diabetes

Diabetes mellitus (DM) is a group of metabolic (metabolic) diseases characterized by hyperglycemia (elevated blood glucose levels) resulting from defects in insulin secretion, insulin action, or both.

Unfortunately, diabetes mellitus is a chronic, completely incurable disease. You will have to learn to live with him, to keep blood glucose levels under control with the help of special procedures, important prescriptions and doctor's recommendations.

In addition, some patients may not even be aware of the existence of diabetes mellitus, since it can proceed completely unnoticed. In such cases, diabetes is detected either during preventive examinations or during examination of another disease. In addition, diabetes manifests itself in different people in different ways and it all depends on the individual characteristics of the body and on the form of manifestation of diabetes itself.

The most common symptoms of diabetes are as follows:

1. Polyuria - increased urine excretion caused by an increase in the osmotic pressure of urine due to the dissolved glucose in it (normally there is no glucose in the urine). Manifested by frequent, profuse urination, including at night.

2. Polydipsia (constant insatiable thirst) - caused by significant losses of water in the urine and an increase in osmotic blood pressure.

3. Polyphagia - constant unquenchable hunger. This symptom is caused by metabolic disorders in diabetes, namely the inability of cells to absorb and process glucose in the absence of insulin (hunger "amid abundance").

4. Weight loss (especially typical for type 1 diabetes) is a common symptom of diabetes, which develops despite the increased appetite of patients. Losing weight (and even depletion) is due to the increased destruction of proteins and fats due to the exclusion of glucose from the energy metabolism of cells.

It should be borne in mind that the symptoms of diabetes depend on the type. Currently, there are:

- DM type 1 (autoimmune, idiopathic).
- SD type 2.

Type 1 diabetes mellitus develops mainly in childhood and adolescence, with this type of diabetes, the production of a vital hormone, insulin, stops. The first clinical manifestations of the disease are: severe thirst, dry mouth, frequent urination, weight loss. The severity of the clinical symptoms of type 1 diabetes mellitus is rapidly growing and, without the provision of the necessary medical care, leads to a serious condition - diabetic hyperglycemic ketoacidotic coma. This type of diabetes mellitus is treated only with insulin replacement therapy.

Type 2 diabetes mellitus usually develops in the adult population. In this type of diabetes, its own insulin is produced, but due to the insensitivity of cells to its action, an increased level of glycemia is formed. Other proven risk factors for the development of type 2 diabetes mellitus are genetic predisposition, as well as the impact of factors such as impaired qualitative and quantitative characteristics in nutrition, decreased physical activity, overweight, chronic stress, smoking and excessive alcohol consumption. Type 2 diabetes mellitus is characterized by the development of severe complications leading to complete disability and premature mortality. Patients with type 2 diabetes mellitus have the same degree of risk of premature death as those who have had myocardial infarction without diabetes mellitus.

In July 2013, the Ministry of Health of the Republic of Belarus approved new clinical protocols for the diagnosis and treatment of endocrine pathology, including diabetes mellitus. Diabetes mellitus can be diagnosed based on 4 criteria:

1. 2-fold value of glucose level in capillary blood in the morning on an empty stomach more than 6.1 mmol / l (in plasma more than 7.0 mmol / l);

2. 2-fold value of glucose level in capillary blood (plasma) during the day more than 11.1 mmol / l;

3. in case of controversy, it is advisable to conduct an oral glucose tolerance test;

4. for the detection of type 2 diabetes mellitus, it is advisable to use the determination of the glycated hemoglobin index, the values of which in a double study of more than 6.5% indicate the presence of this disease in the subject.

In addition, there are conditions preceding diabetes mellitus. This is a violation of glucose tolerance and a violation of fasting glucose. When glucose tolerance is impaired, the patient's blood glucose level is already higher than normal, but lower than that at which the diagnosis of diabetes is made.

The diagnostic importance of this condition is that at this stage it is already possible to identify the threat of developing type 2 diabetes and prevent it in time.

The main goals of treatment are:

compulsory education of the patient;

control and correction of hyperglycemia (normalization of blood glucose levels leads to a noticeable weakening of symptoms), ideally, every patient with diabetes should have a home glucometer to independently determine the concentration of blood glucose;

physical activity;

prevention of acute and long-term complications;

diet (for many products, the calculation of bread units (XE) is required, 1 XE corresponds to 10-12 g of carbohydrates, 1-2 U of insulin is needed for its assimilation).

Despite the advances in diabetology, especially in recent years, diabetes mellitus remains one of the priority diseases for public health, because the social and medical significance of the consequences of the disease is obvious.

The main cause of disability and mortality in diabetes mellitus is vascular complications, the main role in the pathogenesis of which belongs to hyperglycemia. With the development of diabetic microangiopathies, there is an interest in almost all links of microcirculation, activation of blood coagulation processes. Diabetic nephropathy is one of the most severe and prognostically unfavorable complications of diabetes mellitus.

The following prognostically unfavorable complications of diabetes mellitus are:

diabetic retinopathy, as it often leads to blindness and visual disability;

diabetic foot syndrome is the leading cause of gangrene and leg amputation.

Modern methods of treatment of diabetic microangiopathies, based on tight control of the level of glycemia, blood pressure, dyslipidemia and other risk factors, can significantly improve the prognosis of the course of the disease in patients with diabetes mellitus.

The emergence of AI is associated with the creation of electronic-mechanical devices, the behavior of which can be programmed using a set of certain rules applied in accordance with the input data and the internal logic of actions. The need for AI systems was due to the appearance in the 40s and 50s. XX century tasks that were difficult or impossible for a person to solve, but which were quite within the power of electronic devices of that time: decoding secret enemy messages, planning military operations, etc. Further development of AI received a theoretical basis in the form of fundamental works by A. Turing, C. Shannon, J. McCarthy, F. Rosenblatt and other researchers, in which the main provisions of the theory of algorithms, machine learning (ML), information theory, artificial neural networks were formulated, programming languages. The elemental base of AI systems was constantly being improved (from vacuum tubes to transistors, then to integrated circuits), making it possible to solve more and more complex problems.

Conclusion

The introduction of systems based on artificial intelligence is in line with global trends in modern medicine, including the transition to digital and remote technologies, personalization of treatment, high-precision forecasting and a patient-centered approach. There is an obvious need for further research in this direction, with an assessment of the clinical effectiveness of new technologies and their economic justification.

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