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"DIABETES MELLITUS: CAUSES, TREATMENT METHODS, AND MICROBIOLOGICAL FOUNDATIONS"

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Annotation: This article comprehensively discusses the etiology, pathogenesis, clinical forms, modern treatment methods, and microbiological foundations of diabetes mellitus. Today, diabetes mellitus is considered one of the chronic metabolic diseases posing a serious threat to the health of the global population. The disease occurs as a result of insulin deficiency or decreased tissue sensitivity to insulin and is characterized by hyperglycemia. The article scientifically analyzes the mechanisms of development of type 1 and type 2 diabetes, the role of hereditary and external factors, intestinal microbiota, and the significance of microorganisms in the development of diabetes. In addition, streptococcal infections occurring in diabetes, impaired wound healing, diabetic foot syndrome, and changes in the immune system are also examined. Modern treatment methods, insulin therapy, glucose-lowering medications, diet therapy, physical activity, and preventive measures are described in detail. The article highlights the importance of a healthy lifestyle and regular medical supervision in preventing diabetes and reducing its complications.

Keywords: Diabetes mellitus, insulin, hyperglycemia, insulin resistance, microbiota, streptococcal infection, diabetic foot, metabolic disorder, autoimmune process, glucose, HbA1c, diet therapy, microangiopathy, immune system, diabetic complications.

Introduction

Diabetes mellitus is one of the diseases known to humanity since ancient times. Today, it has become a global medical and social problem. According to the World Health Organization, the number of patients suffering from diabetes is increasing year by year. Factors such as urbanization, unhealthy nutrition, sedentary lifestyle, obesity, and stress contribute to the widespread prevalence of the disease.

Diabetes mellitus is a chronic endocrine disease characterized by disturbances in carbohydrate, fat, and protein metabolism, accompanied by elevated blood glucose levels. The main cause of the disease is insufficient production of the hormone insulin or a decrease in its biological effect. Insulin is produced by the beta cells of the pancreas and ensures the uptake of glucose by cells.

Diabetes affects almost all systems of the body. Serious changes occur in the cardiovascular system, kidneys, eyes, nervous system, and skin. In addition, diabetes weakens immune system

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activity, making the body more susceptible to various bacterial and viral infections. In particular, streptococcal and staphylococcal infections can cause severe complications in diabetic patients.

In recent years, the microbiological basis of diabetes has also been widely studied. Changes in the composition of the intestinal microbiota have been found to play an important role in the development of insulin resistance and chronic inflammation. Certain viruses may also trigger autoimmune processes and lead to the development of type 1 diabetes.

This article broadly and scientifically covers the causes, clinical forms, pathogenesis, microbiological aspects, treatment methods, and prevention of diabetes mellitus.

Main Part.

Etiology and Pathogenesis of Diabetes Mellitus

Diabetes mellitus is a chronic endocrine disease associated with metabolic disorders, mainly developing as a result of insulin deficiency or decreased sensitivity to insulin. Insulin is produced by the beta cells of the pancreas and ensures the transport of glucose into cells. If insulin is not produced sufficiently or cells do not respond to it, glucose accumulates in the blood, resulting in hyperglycemia. Consequently, the body's energy metabolism is disrupted, and significant changes occur in carbohydrate, fat, and protein metabolism.

The main forms of diabetes mellitus are type 1 and type 2 diabetes. Type 1 diabetes is an autoimmune disease in which the body's immune system damages the insulin-producing beta cells of the pancreas. As a result, insulin production sharply decreases or stops completely. This type is more common among children, adolescents, and young adults. The disease develops rapidly, and patients require lifelong insulin therapy. Type 2 diabetes, on the other hand, occurs more commonly in adults, and its main cause is reduced sensitivity of cells to insulin, known as insulin resistance. This condition is often associated with unhealthy nutrition, obesity, sedentary lifestyle, and hereditary predisposition.

Hereditary factors play an important role in the development of diabetes mellitus. If parents have diabetes, the risk of developing the disease in their children increases significantly. In addition, environmental factors, chronic stress, harmful habits, and poor nutrition also contribute to the development of diabetes. In recent years, the role of intestinal microbiota in diabetes development has been extensively studied. Intestinal microflora directly affects the immune system and metabolism of the body. A decrease in beneficial bacteria intensifies inflammatory processes and leads to the development of insulin resistance.

Clinical Manifestations

The main clinical signs of diabetes mellitus are associated with elevated blood glucose levels. Patients experience persistent thirst, excessive water intake, frequent urination, weakness, weight loss, dry skin, and slow wound healing. In some cases, decreased vision, numbness in the legs, and skin itching are also observed. Since type 2 diabetes may remain asymptomatic for a long time, many patients are unaware of the disease. Therefore, regular medical examinations are very important.

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Diabetes negatively affects almost all systems of the body. One of the most dangerous complications is cardiovascular disease. Diabetes accelerates the development of atherosclerosis, increasing the risk of myocardial infarction and stroke. In addition, diabetic nephropathy impairs kidney function, while diabetic retinopathy may lead to vision loss and even blindness. Damage to the nervous system causes diabetic neuropathy. In this condition, patients complain of pain, numbness, and reduced sensitivity in the legs.

Microbiological Basis of Diabetes Mellitus

The microbiological basis of diabetes mellitus has become one of the most important research areas in modern medicine. The intestinal microbiota consists of trillions of microorganisms involved in digestion, vitamin synthesis, immune regulation, and metabolic processes. Disturbance of the normal microbial balance, known as dysbiosis, contributes to chronic inflammation and metabolic disorders.

Scientific studies show that patients with type 2 diabetes often have a reduced number of beneficial bacteria such as *Lactobacillus* and *Bifidobacterium*, while opportunistic pathogenic microorganisms increase. This condition disrupts intestinal permeability and allows inflammatory mediators to enter the bloodstream. Chronic low-grade inflammation is considered one of the major mechanisms of insulin resistance.

Certain viral infections may also contribute to the development of diabetes. Enteroviruses, Coxsackie B virus, rubella virus, and cytomegalovirus are considered possible triggers of autoimmune destruction of pancreatic beta cells in genetically predisposed individuals. These infections stimulate immune responses that mistakenly attack pancreatic tissue.

The activity of the immune system is weakened in diabetes mellitus. As a result, the body becomes more susceptible to various bacterial and fungal infections. In particular, streptococcal and staphylococcal infections are more severe in diabetic patients. High glucose levels create a favorable environment for bacterial growth; therefore, wounds become infected quickly and heal very slowly. Diabetic foot syndrome develops as a result of this process. Inflammation around the wound intensifies, necrosis develops, and in severe cases, gangrene may occur.

Fungal infections caused by *Candida albicans* are also frequently observed in diabetic patients. Hyperglycemia weakens local immune defense mechanisms and promotes fungal colonization of the skin and mucous membranes.

Diagnosis of Diabetes Mellitus

The diagnosis of diabetes mellitus is based on laboratory and clinical examinations. The main diagnostic criteria include fasting blood glucose level, oral glucose tolerance test (OGTT), and glycated hemoglobin (HbA1c) analysis.

A fasting plasma glucose level of 7.0 mmol/L or higher and an HbA1c level of 6.5% or higher are considered diagnostic indicators of diabetes mellitus. Urinalysis may also reveal glucosuria and ketonuria, especially in uncontrolled diabetes. Regular monitoring of blood

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glucose levels is extremely important for preventing complications and evaluating treatment effectiveness.

Modern Treatment Approaches

The treatment of diabetes mellitus is carried out comprehensively. In type 1 diabetes, insulin therapy is the main treatment method. Insulin preparations help maintain normal blood glucose levels in patients. Various forms of insulin are used in clinical practice, including rapid-acting, short-acting, intermediate-acting, and long-acting insulin preparations.

In type 2 diabetes, glucose-lowering medications are widely used. Metformin is one of the most commonly recommended drugs, as it increases insulin sensitivity and reduces glucose production in the liver. Modern antidiabetic medications also include:

- Sodium-glucose cotransporter-2 (SGLT2) inhibitors;
- Dipeptidyl peptidase-4 (DPP-4) inhibitors;
- Glucagon-like peptide-1 (GLP-1) receptor agonists;
- Sulfonylurea preparations;
- Thiazolidinediones.

Diet therapy plays an essential role in diabetes management. Patients are advised to limit easily digestible carbohydrates, sugary products, and saturated fats while increasing the intake of vegetables, whole grains, and protein-rich foods. Maintaining an appropriate calorie balance helps control body weight and improve insulin sensitivity. Regular physical activity improves glucose metabolism and reduces insulin resistance. Walking, swimming, cycling, and aerobic exercises are recommended for diabetic patients.

Prevention of Diabetes Mellitus

Preventive measures are highly important in reducing the prevalence of diabetes mellitus. Maintaining a healthy lifestyle, balanced nutrition, regular exercise, and avoiding obesity significantly reduce the risk of developing type 2 diabetes. Early diagnosis through periodic medical examinations allows timely treatment and prevents severe complications. Public awareness campaigns regarding diabetes prevention and healthy living are also important components of healthcare systems worldwide.

Conclusion

Today, diabetes mellitus is one of the most widespread chronic diseases posing a serious threat to human health. The disease develops as a result of insulin deficiency or insulin resistance, causing profound metabolic disorders in the body. Hyperglycemia leads to severe complications in the cardiovascular system, kidneys, eyes, and nervous system, significantly reducing patients' quality of life.

Scientific studies conducted in recent years have made it possible to better understand the microbiological basis of diabetes. Intestinal microbiota, viruses, and bacterial infections have been identified as important factors in the development of the disease. In particular, streptococcal

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infections and impaired wound healing in diabetic patients represent major clinical problems. This demonstrates that, in diabetes treatment, not only glucose control but also strengthening the immune system and preventing infections are essential.

An integrated approach is necessary for the effective management of diabetes mellitus. Proper nutrition, physical activity, modern medications, insulin therapy, and regular medical supervision are important in reducing disease complications. By following a healthy lifestyle and detecting diabetes early, it is possible to improve patients' life expectancy and quality of life.

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