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Diabetes Mellitus: A Brief Review on types and Management Strategies

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Diabetes mellitus is a life-deadliest disease due to its effect on the lives of people. It has drawn a lot of attention recently. The causes of various forms of diabetes, including type 1 & type 2 were discussed along with how they effect those. Younger generation is more prone to type 1 diabetes than older ones who are more likely to have type 2 diabetes mellitus. Now-a-days diabetes mellitus has materialized as a significant global public health concern with an increase in its prevalence. Different types of diabetes mellitus which includes type 1 diabetes (Idiopathic & Fulminant), type 2 diabetes, and gestational disease. The role of inflammation in type 1 and type 2 diabetes is examined, along with mediators and potential anti-inflammatory treatments. The manifestation of pancreatic damages β -cell islet inflammation, oxidative stress, & a impaired insulin production. The treatment options and strategies for two forms of diabetes were also discussed in addition to how the disease affects quality of life of people. People from low and middle income countries are more prone to having diabetes. It is associated with obesity. The progression of the disease over time has been associated with an increase in disability and mortality. Additionally, the impact of diabetes mellitus on these stresses, acute kidney injury, immune system complications and other diabetic complications like retinopathy & neuropathy is also examined. Therefore, further research is required to enhance diagnosis, prevent chronic complications & identify potential therapeutic targets for the maintenance of diabetes mellitus and its associated dysfunctions or abnormality.

Keywords: Diabetes mellitus, β -cell, type 1 and type 2 diabetes, oxidative stress, insulin**ARTICLE INFO****Corresponding Author**

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1. Introduction

Diabetes is a condition that happens when the level of glucose (sugar) in your blood becomes too high. Glucose is body's main source of energy and comes from the food. When food enters into body it turns most of the food into sugar (glucose) and releases it into bloodstream. As blood sugar levels rise, pancreas is signaled to release insulin.

Insulin acts like a key, allowing glucose to enter your cells and be used for energy. Diabetes is a common condition that affects people of all generations. Type 2 diabetes is the most common. A combination of treatment can help to maintain the condition to live a healthy life and prevent from the complications. Diabetes happens when the blood sugar (glucose) is too high. It develops when pancreas

doesn't make enough insulin production or there is a deficiency in it. Most forms of diabetes are chronic (lifelong) and which can be manageable or maintained with several medications or lifestyle changes. Chronic hyperglycemia is a metabolic disorder caused by lack of insulin secretion or production, impaired insulin action. Insulin plays an important role as an anabolic hormone, affecting metabolism of carbohydrates, lipids, and proteins. The metabolic abnormalities associated with diabetes mainly affect tissues such as adipose tissue, skeletal muscles, and other organs due to insulin resistance. Those with a complete lack of insulin, such as children, may develop symptoms such as increased appetite and thirst (polydipsia), dysuria, weight loss, and vision problems. Some people with diabetes may not experience any symptoms, especially type 2 diabetic patients in their early stages. If the diabetes is not controlled, it can lead to various complications such as coma, confusion, and in some cases, death from ketoacidosis or nonketotic hyperosmolar syndrome. The most common treatment for Type 1 is insulin replacement therapy (insulin injection), and for Type 2 diabetes it can be managed by anti-diabetic medications such as metformin, thiazolidinediones, sulfonylureas, etc. Sometimes gestational diabetes is temporary. It usually goes away in a normal resolvable phase after the delivery. The number of people whose high blood glucose level increases during pregnancy is increasing rapidly. Currently, there is no cure for diabetes. However, managing your weight, eating a healthy diet, and staying physically active can make a big difference. Here are other helpful steps: Take medications as directed. Participate in diabetes self-management education and support programs. Attend regular healthcare checkups. The number of diabetes patients has increased globally. In 2021, 10.5% of adults aged 20–79 years (537 million people) were living with diabetes. An increase from 9.3% (463million) in 2019. Half of the people in 2021 aged 20–79 years, older were living with diabetes. The prevalence is projected to increase from 537 million in 2021 to 643 million by 2030 and to 783 million by 2045. In 2021, the diabetes prevalence was estimated to be 9.8% in women and 11.3% in men. Diabetes continues to be a major cause of death and disability. Treatment coverage is very low in low and middle-income countries. In 2021, global treatment coverage for adults aged 20–79 years living with diabetes was projected to be around 50% of the adult population, according to International Diabetes Federation (IDF).

2. Types of Diabetes Mellitus

Type 1 diabetes mellitus:

Type 1 diabetes, formerly referred to as insulin-dependent, also known as juvenile diabetes, is a condition marked by insufficient insulin production. Managing it requires daily insulin injections. As of 2017, an estimated 9 million people worldwide had type 1 diabetes, with most cases occurring in high-income countries. The exact cause of the disease and ways to prevent it remain unknown. Type 1 diabetes (T1D) can be identified well before abnormal insulin secretion begins, with a gradual decline in insulin function often starting at least two years before diagnosis. During this time, there is also a reduction in β -cell

sensitivity to glucose. As the initial insulin response drops, the late-phase insulin response increases, possibly as a compensatory mechanism. After diagnosis, insulin responsiveness continues to decline at an accelerating rate. In the first few years, a two-phase drop in insulin secretion is observed, with a sharper decline during the first year than the second. Once diagnosed, this decrease in insulin production may persist for years, eventually resulting in minimal or no insulin output. Even when glucose levels appear normal, elevated levels may still signal the presence of T1D.

Type 2 diabetes mellitus

Type 2 diabetes affects the way the body processes sugar (glucose) for energy. It interferes with the body's ability to use insulin effectively, which can result in high blood sugar levels if left untreated. Over time, uncontrolled type 2 diabetes can lead to serious complications, particularly damaging the nerves and blood vessels. This form of diabetes is often preventable. Common risk factors include being overweight, physical inactivity, and a family history of the condition. Detecting type 2 diabetes early is essential to avoiding severe health issues. The most effective way to catch it early is through routine medical check-ups and blood tests with a healthcare professional. Over 95% of individuals with diabetes have type 2 diabetes. It was previously known as non-insulin-dependent or adult-onset diabetes. While it used to occur almost exclusively in adults, it is now becoming increasingly common among children as well. The maximum capacity for insulin production and the enhancement of insulin responses to non-glucose triggers due to high blood sugar levels are significantly reduced. Over time, hyperglycemia tends to worsen and becomes increasingly difficult to manage. A continuous decline in β -cell function is another hallmark of type 2 diabetes (T2D) progression.

3. Gestational Diabetes

Gestational diabetes is a condition marked by elevated blood glucose levels that are higher than normal but not high enough to meet the criteria for diabetes. It occurs during pregnancy. Women with gestational diabetes face a greater risk of complications both during pregnancy and at childbirth. Additionally, both the mother and her child may have an increased likelihood of developing type 2 diabetes later in life. This condition is typically identified through routine prenatal screening rather than based on symptoms.

Causes of diabetes:

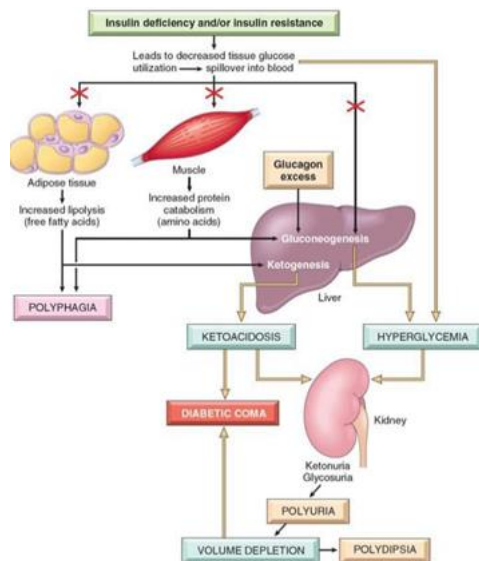
Excess glucose in the bloodstream leads to diabetes, regardless of the type. However, the reason behind elevated blood sugar levels varies depending on the type of diabetes. Common causes of diabetes include;

- Insulin resistance
- Autoimmune disease
- Hormonal imbalances
- Pancreatic damage
- Genetic mutations

Symptoms of diabetes mellitus:

- Symptoms of diabetes includes:
- Excessive thirst (polydipsia) and a dry mouth.
- Frequent urination.

- Feeling unusually tired.
- Blurred vision.
- Unexplained weight loss.
- Tingling or numbness in the hands or feet.
- Wounds or cuts that heal slowly.
- Recurring skin problems or vaginal yeast infections.



Pathophysiology of diabetes mellitus

4. Diagnosis of diabetes mellitus

Diagnosis is diagnose by measuring your blood glucose (sugar) level with a blood test. There are three main tests used to check blood glucose levels:

Fasting blood glucose test: In this test, you must avoid eating or drinking anything except water for at least 8 hours before the test. Since food can change blood sugar levels, this test helps your doctor measure your baseline sugar level.

Random blood glucose test: This test can be done at any time of the day, no matter if you have eaten recently or not.

A1c test: Also known as the HbA1c or glycated hemoglobin test, this shows your average blood sugar levels over the past 2–3 months. To check for and diagnose gestational diabetes, doctors use an oral glucose tolerance test.

Management and treatment:

Diabetes is a complex condition, and its management requires multiple approaches. Since the condition affects each person differently, treatment plans are tailored to individual needs. The four key components of diabetes management are:

Blood sugar monitoring:

Regularly checking blood glucose levels is essential to evaluate how well your treatment plan is working. It provides guidance for managing your condition on a daily and sometimes even hourly basis. Blood sugar can be monitored through finger-stick tests using a glucose meter or with a continuous glucose monitor (CGM). You and your healthcare provider will decide the most suitable target range for you.

Oral diabetes medications:

These medicines, taken by mouth, help control blood sugar in people who still produce some insulin most commonly those with Type 2 diabetes and prediabetes. In some cases, individuals with gestational diabetes may also require oral medications. Several types are available, with metformin being the most widely used.

Insulin therapy: People with Type 1 diabetes must take synthetic insulin to survive and manage their condition. Some individuals with Type 2 diabetes may also need insulin. There are several types of synthetic insulin, each differing in how quickly they begin to work and how long they remain effective in the body. Insulin can be administered in four main ways: injections with a syringe, insulin pens, insulin pumps, and rapid-acting inhaled insulin.

Diet and nutrition: Meal planning and making healthy food choices are essential in diabetes management, as diet has a direct effect on blood sugar. For those taking insulin, carbohydrate counting is a key practice, since the amount of carbohydrates consumed helps determine the insulin dose needed at mealtimes. A balanced diet not only aids in blood sugar control but also supports weight management and lowers the risk of heart disease.

Physical activity:

Regular exercise improves insulin sensitivity and helps decrease insulin resistance, making it a vital part of diabetes management for everyone with the condition. Staying active also plays an important role in maintaining overall health.

Medications for diabetes mellitus:

Oral Medications

Sulfonylureas: act by binding to ATP-sensitive potassium (K-ATP) channels in the pancreatic beta cells. This blocks the channels, alters the resting membrane potential, allows calcium influx, and ultimately stimulates insulin secretion.

Meglitinides: work on different pancreatic beta-cell receptors but have a similar effect to sulfonylureas. By regulating ATP-sensitive potassium channels in beta cells, they promote insulin release.

Thiazolidinediones: activate the nuclear receptor PPAR- γ , which boosts insulin sensitivity and peripheral glucose uptake. They also raise adiponectin levels, a cytokine secreted by fat tissue that promotes insulin sensitivity and fatty acid oxidation.

Alpha-glucosidase: inhibitors block alpha-glucosidase enzymes in the intestinal brush border, slowing the breakdown of dietary starch into glucose and fructose. This reduces polysaccharide absorption and delays carbohydrate metabolism.

DPP-4 inhibitors: block the enzyme dipeptidyl peptidase-4 (DPP-4), preventing the inactivation of hormones like GIP and GLP-1. This enhances glucose control by reducing glucagon secretion, increasing insulin release, slowing gastric emptying, and promoting satiety.

Metformin: Is a biguanide antihyperglycemic used in conjunction with diet and exercise for glycemic control in type 2 diabetes mellitus . it is also used for insulin resistance in polycystic ovary syndrome (pcos)

Brand Names : Actoplus met , apo metformin.

Generic Name: METFORMIN

Biological Source: Metformin is derived from a plant called *Galega officinalis*, commonly known as French lilac or goat's rue. In medieval Europe, goat's rue was traditionally used to treat various ailments such as fever, seizures, and parasitic infections.

Mechanism of Action: Metformin enhances the activity of AMP-activated protein kinase in the liver. This reduces gluconeogenesis and fat synthesis while improving insulin-mediated glucose uptake in muscles.

Pathophysiology:

Therapeutic uses:

- Metformin is the first line medication used to lower blood glucose levels, it helps to improve the body response to insulin and decreases glucose production in the liver.
- Metformin helps regulate menstrual cycles, improve ovulation, and reduce insulin resistance in women with PCOS.

5. Injectable Medication

There are many different types of injectable diabetes medications, including insulin and non-insulin injections.

Synthetic human insulins:

Synthetic insulin are created in a laboratory, can be either short-acting (called "regular" insulin) or intermediate-acting (NPH insulin). Both are available in over-the-counter (OTC) formulations. Few examples includes Novolin R, Humulin R, Novolin N and Humulin N.

Insulin analogs: are modified forms of human insulin created to work in specific ways within the body. They were developed shortly after synthetic human insulin became available.

3) GLP-1 agonists:

Glucagon-like peptide 1 (GLP-1) agonists are a class of Type 2 diabetes medication that work by mimicking a gut hormone called GLP-1. This has several effects, including triggering insulin release after meals, decreasing glucose production in the liver, and slowing down how fast your stomach empties. Together, these effects can help improve blood glucose levels with a low risk of hypoglycemia. GLP-1 agonists can also cause weight loss, making them a good option for people with diabetes who are trying to lose weight. Several also have proven benefits for people with heart disease. GLP-1 agonists can be used on their own or in combination with insulin or oral diabetes medications.

6. Conclusion

Diabetes places a significant financial burden on affected families and is linked to serious complications that may lead to death. There are two main types of diabetes mellitus: Type 1 Diabetes Mellitus (T1DM), which is more common in children, and Type-2 Diabetes Mellitus (T2DM), which occurs more often in adults. Certain risk factors in children can contribute to the development of T2DM, negatively impacting their health. Diabetes is also associated with severe complications that cause increased suffering and premature death. The likelihood of developing diabetes is influenced by factors such as race, ethnicity, and lifestyle, which may be connected to social and economic conditions. Fortunately, for those living with

this disease, both preventive interventions and treatment options are available.

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