

Sweet Trouble: The Hidden Danger of Diabetes Mellitus



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Abstract

Diabetes mellitus (DM), also known as just diabetes, is a collection of metabolic illnesses characterized by elevated blood sugar levels, either as a result of insufficient insulin production by the body or in response to the insulin produced by cells. The characteristic symptoms of polyuria (frequent urine), polydipsia (increased thirst), and polyphagia (increased appetite) are brought on by this elevated blood sugar. Diabetes is traditionally classified into three types: Type 1 diabetes, also known as insulin-dependent diabetes mellitus (IDDM), in which the body is unable to manufacture insulin and the patient must currently inject insulin or wear an insulin pump. "Juvenile diabetes" is another name for this. Insulin resistance, a disorder in which cells do not use insulin as intended, with or without a complete insulin deficit, is the cause of type 2 diabetes, also known as non-insulin-dependent diabetic mellitus (NIDDM). "Adult-onset diabetes" was the prior term for this kind. Gestational diabetes, the third major form, is brought on by elevated blood glucose levels in pregnant women who have never had diabetes before. It might appear before type 2 DM develops. Insulin and oral hypoglycemic medications are among the pharmacological options currently available for the treatment of diabetes mellitus. These medications work by either boosting the pancreatic production of insulin or lowering plasma glucose levels by promoting glucose absorption and inhibiting gluconeogenesis.

Introduction:

Over 100 million people globally (6% of the population) suffer with diabetes mellitus (DM), the most prevalent endocrine condition. It is brought on by insufficient or inefficient insulin production by the pancreas, which causes blood glucose levels to rise or fall. Numerous bodily systems have been discovered to be harmed by it, including the heart, kidney, blood vessels, eyes,

and nerves (Mekala and Bertoni, 2020; Ismail, 2009). Insulin-dependent diabetes mellitus (IDDM, Type I) and non-insulin-dependent diabetes mellitus (NIDDM, Type II) are the two categories of diabetes mellitus. While Type II diabetes is defined by peripheral insulin resistance and decreased insulin secretion (Jansson, 2007; Arora et al., 2009). Type I diabetes is an autoimmune illness that is characterized by a local

inflammatory response in and around islets, followed by the selective death of cells that secrete insulin (Roep et al., 2021; Arora et al., 2009). Diabetes mellitus increases the risk of numerous consequences, including peripheral and cardiovascular illnesses, stroke, neuropathy, renal failure, retinopathy, blindness, amputations, and more (Mezil and Abed, 2021; Jothivel *et al.*, 2007). The main purposes of drugs are symptom relief and life preservation. Preventing long-term diabetes problems and extending life expectancy by removing risk factors are secondary goals. Patients with type 1 diabetes are treated primarily with insulin replacement medication, whereas type 2 diabetes is treated and managed mostly with dietary and lifestyle changes. Diabetes can also be treated with a variety of hypoglycemic medications, including sulfonylureas and biguanides. But none of these drugs are the best because of their harmful side effects, and sometimes long-term use results in diminished responses (Dixit and Joshi, 1985). The primary drawback of the medications that are now on the market is that they must be used continuously throughout life and have adverse effects (Craik et al., 2013; Halin, 2003). Throughout the world, medicinal plants and their bioactive components can be used to treat diabetes mellitus, particularly in nations with limited access to traditional anti-DM medications. Plants antidiabetic properties can also be screened using a variety of experimental methods.

Pathophysiological aspects

Insulin insensitivity brought on by insulin resistance, decreased insulin synthesis, and ultimately pancreatic beta-cell loss are the hallmarks of type 2 diabetes. As a result, there is less glucose transported into the muscle, fat, and liver cells. Hyperglycemia causes an increase in the breakdown of fat (Fuentes et al., 2023; Kahn and Banting, 1994; Robertson, 1995). Patients with type 1 diabetes are typically young (children or teenagers) and not obese when their symptoms initially appear. With a 10-fold higher frequency

in first-degree relatives of an index case and substantial correlations with specific histocompatibility antigens (HLA types), there is a genetic tendency. Genetically predisposed people must also be exposed to an environmental trigger, like a viral infection, according to studies on identical twins. In addition to exposing antigens that start a self-replicating autoimmune response, viral infections can harm pancreatic B cells. Only when over 90% of the B cells have been killed does the patient become clearly diabetic. This kind of insulin insufficiency weakens long-term potentiating and may result in memory and learning impairments. Both insulin resistance and decreased insulin production are associated with type 2 diabetes, and both are crucial to the disease's etiology (Dutta et al., 2022). These patients often appear in adulthood and are frequently obese; as B-cell activity deteriorates with age, the incidence increases gradually. In this case, tau hyperphosphorylation and A β plaque development are both caused by insulin resistance. Insulin and A β compete for the insulin-degrading enzyme during hyperinsulinemia, which causes A β buildup and plaque development. Reduced insulin receptor signaling causes tau hyperphosphorylation, Akt inhibition, and GSK-3 β dephosphorylation (activation).

Diagnosis:

Although postprandial blood sugar, random blood sugar, and glucose tolerance tests are also used to determine blood sugar, the American Diabetes Association (ADA) states that the fasting glucose concentration should be utilized in routine diabetes screening. At least one of the following criteria must be met in order to diagnose diabetes: Diabetes symptoms, such as polyuria, polydipsia, and inexplicable weight loss, together with a casual plasma glucose level of 11.1 mmol/L (200 mg/dL).

Fasting plasma glucose = When no calories are consumed for at least eight hours, it typically ranges between 70 and 110 mg/dl.

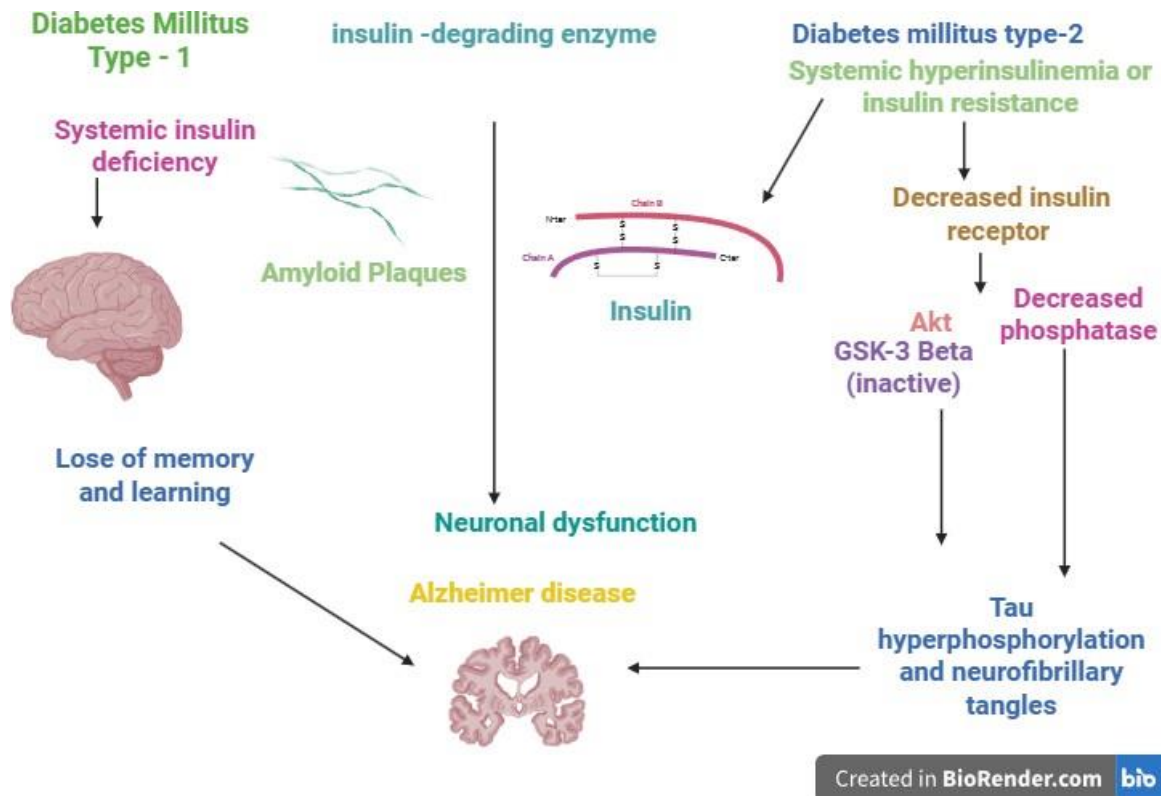


Fig. 1: Pathophysiology of Type I and Type II diabetes. Abbreviations: A β - Amyloid- β , GSK-3 β -glycogen synthase kinase 3 β .

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Treatment

Since nature is so effective at reducing postprandial hyperglycemia and avoiding hypoglycemia in between meals, insulin therapy should try to emulate it (Papakonstantinou *et al.*,

2022; Ciofeta *et al.*, 1999). Insulin injections can be administered intramuscularly or intravenously, and the site of administration is equally crucial for improved and safe action of insulin. There are various forms of insulin available, including human, cow, and hog insulin. Insulin treatment has side effects and problems. Weight gain and hypoglycemia are the two main side effects that occur when an incorrect insulin dosage is administered and when meals and insulin injections are not timed correctly (Robinson *et al.*, 2021; Henry *et al.*, 1993; Kudlacek and Schernthaner, 1992). Increased truncal fat and muscle bulk are the causes of weight gain, which is an inevitable side effect of beginning insulin therapy for uncontrolled diabetes. Reduced energy losses from glycosuria are also to blame for this (Yki-Jarvinen *et al.*, 1999). Oral hypoglycemic medications include biguanides like metformin and phenformin and sulphonyl ureas like glibenclamide and glipizide.

Sulfonylureas stimulate the release of insulin from pancreatic β -cells, which results in hypoglycemia. When they attach to β -cell plasma membrane sulfonylurea (SUR) receptors, adenosine triphosphate (ATP)-sensitive potassium channels close, depolarizing the cell membrane. Voltage-gated channels are then opened, permitting calcium ions to enter and the subsequent release of produced insulin granules (Kopf and Copello, 2024). When sulfonylureas are given acutely to patients with type 2 diabetes, the pancreas releases more insulin, and this may raise insulin levels by decreasing the hormone's hepatic clearance. According to preliminary research, sulfonylureas hypoglycemic effects need a functioning pancreas (Levine, 1984). Metformin and other biguanides are antihyperglycemic, not hypoglycemic (Bailey, 1992). Even at high dosages, it does not result in hypoglycemia or the release of insulin from the pancreas (Clarke and Duncan, 1974). When taken orally rather than intravenously, it has been demonstrated to enhance peripheral glucose uptake and decrease hepatic glucose production by roughly 20–30%. Another mechanism of action that has been proposed is impaired intestinal absorption of glucose (Hundal et al., 1992).

Conclusion

The word "diabetes mellitus" refers to a group of metabolic diseases that, if untreated, all cause the blood to have excessively high levels of the sugar glucose. When the pancreas stops producing a sizable amount of the hormone insulin, it is known as diabetes mellitus type 1. This is typically caused by the autoimmune death of the pancreatic beta cells that create insulin. On the other hand, it is now believed that insulin resistance and/or pancreatic autoimmune assaults cause diabetes mellitus type 2. A person with type 2 diabetes may have normal or even abnormally high insulin production from their pancreas. Restoring a normal state of glucose metabolism is the primary objective of diabetic therapy. People

who have a complete insulin shortage need insulin replacement therapy, which is administered as injections or pills, in order to accomplish this aim. On the other hand, dietary changes and physical activity can help improve insulin resistance. Preventing or treating the numerous problems that can arise from both the disease and its treatment are additional objectives of diabetes care. Diabetes may be managed so that the patient can live a happy life by controlling their blood sugar levels.

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