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Diabetes Mellitus: A Comprehensive Overview of Pathophysiology, Risk Factors, Diagnosis, Complications, and Management

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Annotation: Diabetes mellitus is a chronic metabolic disease characterized by sustained high blood sugar levels due to impaired insulin secretion, resistance to insulin action, or both. It includes type 1 and type 2 diabetes, each with distinct mechanisms but sharing common complications and management challenges. Over recent decades, the prevalence of diabetes has increased dramatically worldwide, becoming a major public health issue with significant social and economic consequences. This review summarizes the essential aspects of diabetes mellitus, including its classification, underlying causes, risk factors such as genetics, obesity, and sedentary lifestyle, as well as current diagnostic criteria. The short- and long-term complications—ranging from acute metabolic disturbances to chronic organ damage—are also discussed, with an emphasis on cardiovascular, renal, and neurological outcomes. Management strategies are explored from a modern perspective, covering insulin therapy, oral medications, lifestyle interventions, and patient education. The review also highlights new therapeutic options such as GLP-1 receptor agonists and SGLT2 inhibitors, which offer improved glycemic control and cardiovascular protection. Preventive measures, including early screening and public health initiatives, are emphasized as crucial tools in reducing the growing burden of diabetes globally. Overall, this article provides a concise yet comprehensive overview of diabetes mellitus, aiming to inform healthcare professionals and support more effective, integrated approaches to treatment and prevention.

Keywords: Diabetes mellitus, insulin resistance, type 1 diabetes, type 2 diabetes, insulin resistance, complications, management.

Introduction.

Diabetes mellitus refers to a group of chronic metabolic disorders characterized by persistently elevated blood glucose levels due to impaired insulin production, insulin resistance, or both. As a global health concern, diabetes has reached alarming proportions in recent years. According to the International Diabetes Federation, approximately 537 million people were living with diabetes in 2021—a number projected to rise to 643 million by 2030 [4]. This surge presents significant challenges not only for individual health but also for healthcare systems worldwideThe two most common forms of diabetes are type 1 diabetes (T1D) and type 2 diabetes (T2D). Type 1 diabetes is typically an autoimmune condition that leads to the destruction of pancreatic β-cells, resulting in absolute insulin deficiency [2]. In contrast, type 2 diabetes is primarily associated with insulin resistance combined with a relative lack of insulin secretion [3]. While the pathophysiology differs, both forms contribute substantially to morbidity and mortality across all age groups.Diabetes is a leading cause of severe complications such as vision loss, chronic kidney disease, cardiovascular events, stroke, and lower limb amputations. Inadequate glycemic control is strongly linked to both microvascular and macrovascular complications, which often progress silently until advanced stages [13]. Timely diagnosis, continuous monitoring, and evidence-based management strategies are essential to reduce disease-related complications and improve quality of life for patients living with diabetes.

Materials and Methods

This review synthesizes current knowledge on diabetes mellitus using data sourced from PubMed, Scopus, and the WHO database. Articles and clinical guidelines published between 2010 and 2023 were selected. Search terms included "diabetes mellitus," "hyperglycemia," "insulin resistance," "complications," and "treatment." A total of 45 peer-reviewed articles, reviews, and official guidelines were included based on relevance, recency, and scientific quality.

Results

3.1 Classification of Diabetes

Diabetes is primarily categorized as:

- ✓ Type 1 Diabetes (T1D): An autoimmune condition leading to β-cell destruction [2].
- ✓ Type 2 Diabetes (T2D): Characterized by insulin resistance and β-cell dysfunction [3].
- ✓ Gestational Diabetes Mellitus (GDM): Hyperglycemia first detected during pregnancy [1].
- ✓ Other Specific Types: Includes monogenic diabetes and secondary forms [1].

3.2 Pathophysiology

In T1D, T-cell mediated autoimmune destruction of pancreatic β-cells leads to absolute insulin deficiency [2]. T2D involves peripheral insulin resistance, increased hepatic glucose output, and eventual β-cell failure [3]. Inflammation, obesity, and genetic predisposition contribute significantly to this process [13].

3.3 Risk Factors

T1D risk factors include family history and autoimmune markers [2]. T2D is associated with obesity, sedentary lifestyle, poor diet, age >45, and hypertension [5]. Ethnicity and genetic susceptibility also play a role [15].

3.4 Diagnosis

According to the American Diabetes Association (ADA) [1], diagnosis is confirmed by:

- ✓ Fasting plasma glucose ≥126 mg/dL
- ✓ 2-hour plasma glucose ≥200 mg/dL during OGTT
- ✓ HbA1c ≥6.5%
- ✓ Random plasma glucose ≥200 mg/dL in symptomatic patients

3.5 Complications

Microvascular complications include retinopathy [12], nephropathy [13], and neuropathy. Macrovascular complications involve coronary artery disease, stroke, and peripheral artery disease [6]. Acute complications include diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) [8].

3.6 Management

Lifestyle interventions (diet, exercise, smoking cessation) are foundational [5]. Pharmacologic therapy includes metformin, SGLT2 inhibitors, GLP-1 receptor agonists, and insulin [11]. T1D requires insulin therapy exclusively [1]. Newer agents like GLP-1 RAs and SGLT2 inhibitors show cardiovascular and renal benefits [10].

Discussion

Diabetes prevalence is increasing due to lifestyle changes and urbanization [15]. While T1D cannot be prevented, T2D can often be delayed or prevented through lifestyle modifications [5]. Comprehensive care reduces complications and improves quality of life [14].

Technological advances include continuous glucose monitoring (CGM), insulin pumps, and closed-loop systems [1]. New drug classes improve not only glycemic control but also cardiovascular outcomes [10]. However, disparities in healthcare access and health literacy remain challenges [6].

Conclusion

Diabetes mellitus remains a major global health challenge, driven by complex genetic, environmental, and lifestyle-related factors. Its progressive nature and association with life-threatening complications such as cardiovascular disease, renal failure, and neuropathy underscore the urgency of effective intervention. Early detection, preventive measures, and patient-centered, multidisciplinary management are critical to minimizing long-term consequences and improving outcomes.To address the growing prevalence and impact of diabetes, it is essential to promote public awareness, strengthen healthcare infrastructure, and support access to affordable care. Continued investment in scientific research and innovation will play a vital role in developing more effective therapies and personalized treatment strategies. At the same time, equitable health policy reforms are necessary to ensure that these advances benefit populations across diverse regions and socioeconomic backgrounds.

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