

Comprehending diabetic cardiomyopathy: An understated menace.

Sanjiv Dhina*

Department of Physiology and Pathophysiology, Institute of Cardiovascular Sciences, University of Manitoba, Canada

Introduction

Diabetes, a chronic condition characterized by high blood sugar levels, affects millions worldwide. Beyond its well-known complications like neuropathy, nephropathy, and retinopathy, diabetes also poses a significant risk to the heart. Diabetic cardiomyopathy, a lesser-known but potentially life-threatening complication, deserves closer attention due to its rising prevalence and profound impact on cardiovascular health.

Diabetic cardiomyopathy refers to a disorder of the heart muscle in individuals with diabetes, leading to structural and functional abnormalities independent of other cardiovascular risk factors such as hypertension or coronary artery disease. Unlike other forms of heart disease, diabetic cardiomyopathy doesn't necessarily involve blocked arteries or prior heart attacks. Instead, it's primarily associated with changes in the structure and function of the heart muscle itself.

Pathophysiology

The exact mechanisms underlying diabetic cardiomyopathy are complex and multifactorial. Chronic hyperglycemia, insulin resistance, oxidative stress, inflammation, and metabolic abnormalities contribute to the development and progression of this condition. Hyperglycemia, the hallmark of diabetes, triggers a cascade of metabolic and molecular changes within cardiac cells. Increased levels of glucose can lead to the formation of advanced glycation end products (AGEs), which accumulate in cardiac tissues, impairing their function and structure [1]. Additionally, insulin resistance, a common feature of type 2 diabetes, promotes abnormal lipid metabolism and alters signaling pathways involved in cardiac remodelling [2, 3].

Oxidative stress, arising from an imbalance between reactive oxygen species (ROS) production and antioxidant defenses, further exacerbates cardiac damage in diabetes. Chronic inflammation, mediated by cytokines and immune cells, contributes to fibrosis, hypertrophy, and dysfunction of the heart muscle. These interconnected pathways ultimately lead to myocardial fibrosis, stiffening of the heart chambers, impaired relaxation, and reduced contractility characteristic of diabetic cardiomyopathy [4].

Clinical manifestations

Diabetic cardiomyopathy typically progresses silently over years, often without noticeable symptoms until advanced

stages. However, as the condition advances, individuals may experience symptoms such as fatigue, shortness of breath, exercise intolerance, and swelling in the lower extremities due to fluid retention. These symptoms often overlap with those of other cardiac conditions, making early detection and diagnosis challenging [5].

Furthermore, individuals with diabetic cardiomyopathy are at increased risk of developing other cardiovascular complications, including heart failure, arrhythmias, and sudden cardiac death [6,7]. Diabetic patients are also more prone to silent myocardial ischemia, where the blood flow to the heart is insufficient despite the absence of typical anginal symptoms.

Diagnostic approaches

Diagnosing diabetic cardiomyopathy requires a comprehensive evaluation involving medical history, physical examination, and various diagnostic tests. Electrocardiography (ECG) may reveal nonspecific changes such as prolonged QT intervals or evidence of left ventricular hypertrophy. Echocardiography, a key imaging modality, allows assessment of cardiac structure and function, identifying features like left ventricular hypertrophy, diastolic dysfunction, and reduced ejection fraction [8].

Additional imaging techniques such as cardiac magnetic resonance imaging (MRI) and myocardial perfusion scans may be employed to assess myocardial tissue characteristics and detect ischemia or fibrosis. Biomarkers like brain natriuretic peptide (BNP) and troponin levels can provide valuable prognostic information and aid in risk stratification.

Management and treatment

The management of diabetic cardiomyopathy involves a multifaceted approach aimed at controlling blood sugar levels, optimizing cardiovascular risk factors, and preventing further cardiac damage. Lifestyle modifications, including a healthy diet, regular exercise, smoking cessation, and weight management, play a crucial role in managing diabetes and reducing cardiovascular risk [9].

Pharmacological interventions targeting diabetes management, blood pressure control, and lipid-lowering therapy are essential components of treatment. Antihyperglycemic agents such as metformin, sodium-glucose cotransporter-2 (SGLT2)

*Correspondence to: Sanjiv Dhina, Department of Physiology and Pathophysiology, Institute of Cardiovascular Sciences, University of Manitoba, Canada, E-mail: sdhina@sbr.ca

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inhibitors, and glucagon-like peptide-1 (GLP-1) receptor agonists have shown cardioprotective effects beyond glycemic control, reducing the risk of cardiovascular events and heart failure in diabetic patients.

In individuals with heart failure and reduced ejection fraction, guideline-directed medical therapy including beta-blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), and mineralocorticoid receptor antagonists can improve symptoms, reduce hospitalizations, and prolong survival. For those with heart failure and preserved ejection fraction, management focuses on controlling blood pressure, optimizing volume status, and addressing comorbidities such as atrial fibrillation or valvular heart disease.

In selected cases, advanced therapies such as cardiac resynchronization therapy (CRT) or implantable cardioverter-defibrillators (ICDs) may be considered to improve cardiac function and reduce the risk of sudden cardiac death [10]. In severe cases refractory to medical therapy, heart transplantation or mechanical circulatory support devices like ventricular assist devices (VADs) may be necessary.

Conclusion

Diabetic cardiomyopathy represents a significant and growing burden on global health, affecting individuals with diabetes and predisposing them to serious cardiovascular complications. Despite advances in diagnostic techniques and treatment modalities, early detection and intervention remain paramount in mitigating the progression of this condition and improving outcomes. A comprehensive approach encompassing glycemic control, cardiovascular risk factor management, and targeted therapies tailored to individual patient characteristics is essential in addressing the complex interplay of metabolic, inflammatory, and oxidative processes underlying diabetic cardiomyopathy. Through continued research, education, and interdisciplinary collaboration, we can strive to better understand and effectively manage this silent yet formidable threat to cardiovascular health in diabetic patients.

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