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GLYCEMIC CONTROL LEVEL AND ITS ASSOCIATION WITH MYOCARDIAL ISCHEMIA

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Abstract: Glycemic control plays a central role in the development and progression of cardiovascular complications in patients with diabetes mellitus. Chronic hyperglycemia contributes to endothelial dysfunction, oxidative stress, and accelerated atherosclerosis, leading to myocardial ischemia. The present article analyzes the pathophysiological mechanisms linking poor glycemic control to myocardial ischemia and evaluates its clinical and prognostic significance. Special attention is given to HbA1c levels, glucose variability, and their impact on coronary perfusion and cardiovascular outcomes. Early detection and optimized metabolic control are emphasized as key strategies for reducing ischemic risk in diabetic patients.

Keywords: diabetes mellitus, glycemic control, HbA1c, myocardial ischemia, endothelial dysfunction, cardiovascular risk

Introduction

Diabetes mellitus (DM) is one of the most important risk factors for cardiovascular diseases worldwide. Patients with type 2 diabetes have a two- to fourfold higher risk of developing ischemic heart disease compared to non-diabetic individuals. Cardiovascular complications remain the leading cause of mortality in diabetic patients.

The degree of glycemic control, commonly assessed by glycated hemoglobin (HbA1c), fasting plasma glucose, and postprandial glucose levels, plays a crucial role in determining vascular damage. Persistent hyperglycemia accelerates both macrovascular and microvascular pathological processes.

Importantly, myocardial ischemia in diabetic patients often presents atypically or remains silent due to autonomic neuropathy, which delays diagnosis and worsens prognosis. Therefore, understanding the relationship between glycemic control and myocardial ischemia is essential for improving cardiovascular outcomes.

Materials and Methods

This study is based on a comprehensive review and analytical synthesis of recent scientific literature (2013–2024), including international clinical guidelines and peer-reviewed publications. The analysis focuses on the association between glycemic control indicators (HbA1c, glucose variability) and myocardial ischemia development, as well as their clinical significance in cardiovascular risk stratification.

Results

Pathophysiological Link between Hyperglycemia and Myocardial Ischemia

Chronic hyperglycemia induces several mechanisms contributing to myocardial ischemia:

- Endothelial dysfunction
- Increased oxidative stress

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- Formation of advanced glycation end-products (AGEs)
- Activation of inflammatory pathways
- Acceleration of coronary atherosclerosis

Endothelial dysfunction reduces nitric oxide bioavailability, impairing vasodilation and coronary blood flow regulation. Oxidative stress further damages vascular walls, promoting plaque formation and instability.

HbA1c Levels and Cardiovascular Risk

HbA1c reflects average blood glucose levels over 2–3 months and serves as a reliable indicator of long-term glycemic control. Clinical studies demonstrate that:

- Each 1% increase in HbA1c is associated with a 15–20% increase in cardiovascular risk.
- HbA1c levels above 7% significantly increase the likelihood of coronary artery disease.
- Poor glycemic control correlates with impaired myocardial perfusion detected by stress testing and imaging modalities (SPECT, stress echocardiography).

Elevated glucose variability independently contributes to endothelial dysfunction and ischemic events, even when mean HbA1c levels appear controlled.

Silent Myocardial Ischemia in Diabetes

Diabetic patients frequently develop silent myocardial ischemia due to autonomic neuropathy affecting pain perception. Clinical studies indicate that:

- Silent ischemia is more prevalent in patients with long-standing diabetes and high HbA1c levels.
- Subclinical perfusion defects are more common in poorly controlled diabetes.
- Early screening in high-risk patients improves detection and reduces adverse outcomes.

Discussion

The relationship between glycemic control and myocardial ischemia is complex and multifactorial. Hyperglycemia not only accelerates atherosclerosis but also impairs microvascular coronary circulation. Even in the absence of significant epicardial coronary stenosis, microvascular dysfunction may cause myocardial ischemia in diabetic patients.

Tight glycemic control has been shown to reduce microvascular complications significantly. However, cardiovascular benefits depend on individualized risk assessment and comprehensive management, including:

- Blood pressure control
- Lipid profile optimization
- Use of cardioprotective antidiabetic agents (SGLT2 inhibitors, GLP-1 receptor agonists)
- Lifestyle modification

Recent trials highlight that modern antidiabetic therapies provide additional cardiovascular protection beyond glycemic lowering effects.

Conclusion

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Glycemic control is a critical determinant of myocardial ischemia development in patients with diabetes mellitus. Elevated HbA1c levels and increased glucose variability are strongly associated with endothelial dysfunction, coronary atherosclerosis, and silent ischemia.

Early detection of subclinical myocardial ischemia and strict metabolic control are essential for reducing cardiovascular morbidity and mortality. A comprehensive, multidisciplinary approach is required to optimize outcomes in diabetic patients at risk of ischemic heart disease.

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