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CLINICAL SIGNIFICANCE OF DETECTION AND ASSESSMENT OF SUBCLINICAL MYOCARDIAL ISCHEMIA IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Abstract: Type 2 diabetes mellitus (T2DM) is a major metabolic disorder associated with a markedly increased risk of cardiovascular complications. Subclinical myocardial ischemia frequently develops in patients with T2DM without overt clinical symptoms, remaining undetected for prolonged periods and contributing to adverse cardiovascular outcomes. This article examines the clinical significance of early detection and assessment of subclinical myocardial ischemia in patients with T2DM, with particular emphasis on underlying microvascular dysfunction, endothelial impairment, and autonomic neuropathy. The role of non-invasive diagnostic methods, including electrocardiographic monitoring and advanced echocardiographic techniques, is highlighted as essential for timely risk stratification and prevention of disease progression. Understanding the mechanisms and clinical implications of subclinical myocardial ischemia may improve cardiovascular risk management and long-term prognosis in patients with T2DM.

Keywords: type 2 diabetes mellitus, subclinical myocardial ischemia, silent ischemia, endothelial dysfunction, cardiovascular risk assessment

Introduction

Over recent decades, type 2 diabetes mellitus (T2DM) has been recognized as one of the leading risk factors for cardiovascular diseases. Epidemiological data indicate that the incidence of ischemic heart disease (IHD) in patients with T2DM is 2–4 times higher than in the general population. Of particular concern is **subclinical myocardial ischemia**, which develops without typical clinical manifestations and therefore remains undiagnosed for a long period. This condition significantly increases the risk of myocardial infarction, heart failure, and sudden cardiac death.

In patients with T2DM, myocardial ischemia often has a silent or atypical course due to diabetic autonomic neuropathy, reduced pain perception, and chronic metabolic disturbances. As a result, the early detection and clinical assessment of subclinical myocardial ischemia have become a major challenge in modern diabetology and cardiology.

Pathophysiological Basis of Subclinical Myocardial Ischemia

The development of subclinical myocardial ischemia in T2DM is associated with complex and interrelated pathophysiological mechanisms.

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First, **insulin resistance and chronic hyperglycemia** lead to endothelial dysfunction. Reduced nitric oxide (NO) bioavailability impairs coronary vasodilation, resulting in decreased myocardial perfusion.

Second, **diabetic microangiopathy** causes structural alterations in the myocardial capillary network. Thickening of capillary basement membranes, reduced capillary density, and increased vascular stiffness impair oxygen delivery to cardiomyocytes.

Third, **atherogenic dyslipidemia**, which is characteristic of T2DM, accelerates atherosclerotic changes in coronary arteries. However, in subclinical ischemia, microvascular dysfunction often plays a more significant role than epicardial coronary artery stenosis.

Finally, **diabetic autonomic neuropathy** reduces ischemic pain sensitivity by disrupting afferent neural pathways, leading to a "silent" course of myocardial ischemia despite significant myocardial hypoxia.

Methods for Detection of Subclinical Myocardial Ischemia

Traditional clinical evaluation alone is insufficient for the detection of subclinical myocardial ischemia; therefore, instrumental and functional diagnostic methods are essential.

Resting electrocardiography (ECG) often fails to reveal ischemic changes. However, **24-hour Holter monitoring** allows the detection of transient ST-segment depression, silent ischemic episodes, arrhythmias, and heart rate variability abnormalities, making it a valuable screening tool.

Exercise stress testing (treadmill or bicycle ergometry) provides functional assessment of myocardial ischemia under physical load. Nevertheless, autonomic dysfunction in T2DM patients may limit test sensitivity and reduce diagnostic accuracy.

Echocardiography, particularly tissue Doppler imaging and strain analysis, plays a crucial role in identifying subclinical systolic and diastolic dysfunction. Reduced **global longitudinal strain (GLS)** is considered an early marker of myocardial ischemia and dysfunction before the appearance of overt clinical symptoms.

Advanced imaging techniques such as **stress echocardiography**, **myocardial perfusion SPECT**, and **cardiac magnetic resonance imaging (MRI)** offer high diagnostic accuracy, enabling precise localization and severity assessment of ischemic areas.

Clinical Significance and Prognostic Implications

The detection of subclinical myocardial ischemia in patients with T2DM has substantial clinical significance. Numerous studies have demonstrated that patients with silent ischemia have a significantly higher risk of developing overt IHD, myocardial infarction, and heart failure.

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Subclinical myocardial ischemia is considered an **independent predictor of adverse cardiovascular outcomes**, particularly in patients with long-standing diabetes, poor glycemic control, arterial hypertension, and concomitant metabolic disorders.

Early identification of this condition allows clinicians to optimize therapeutic strategies, including intensified glycemic control, initiation of cardioprotective agents (ACE inhibitors, beta-blockers, statins), and targeted lifestyle modifications. These interventions may substantially reduce cardiovascular morbidity and mortality in diabetic patients.

Conclusion

Subclinical myocardial ischemia is a common but frequently underdiagnosed condition in patients with type 2 diabetes mellitus. Its development is driven by metabolic abnormalities, microvascular dysfunction, and autonomic neuropathy. The absence of typical clinical symptoms complicates early diagnosis; however, modern non-invasive diagnostic methods provide effective tools for timely detection. Early identification and appropriate assessment of subclinical myocardial ischemia play a pivotal role in reducing cardiovascular risk, improving long-term prognosis, and enhancing quality of life in patients with type 2 diabetes mellitus.

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