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IMPACT OF INSULIN RESISTANCE ON THE DEVELOPMENT OF CARDIOVASCULAR DISEASES

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Insulin resistance is a metabolic disorder characterized by decreased sensitivity to insulin, which leads to impaired glucose uptake and dysregulation of lipid metabolism. This condition is a major risk factor for the development of cardiovascular diseases, including atherosclerosis, hypertension, and coronary artery disease. This review article synthesizes current research on the impact of insulin resistance on cardiovascular health through a comprehensive literature search of databases such as PubMed, Scopus, and Web of Science. Understanding the mechanisms underlying the relationship between insulin resistance and cardiovascular dysfunction is critical to developing effective prevention and treatment strategies. These associations are multifactorial and include oxidative stress, inflammation, lipid dysregulation, and altered vascular function. Oxidative stress caused by increased production of reactive oxygen species in insulin-resistant states impairs the bioavailability of nitric oxide and induces pro-inflammatory signaling pathways, thereby promoting endothelial function. This oxidative environment promotes atherosclerosis by recruiting inflammatory cells, proliferating vascular smooth muscle cells, and forming lipid plaques. Inflammation is an example of insulin resistance, which increases insulin resistance, leading to dysfunction and atherosclerosis. The expression of adhesion molecules, cytokines, and chemokines perpetuates a vicious cycle of vascular injury and inflammation. Dyslipidemia is characterized by increased triglyceride levels, decreased HDL cholesterol levels, and increased small, dense LDL particles, leading to the formation of atherosclerotic plaques that predispose to heart disease. Additionally, insulin resistance disrupts the balance between vasoconstriction and vasodilation, promoting a pro-thrombotic, pro-atherogenic vascular phenotype characterized by NO-mediated vasodilation. and myocardial infarction. Despite the clear link between insulin resistance and heart disease, the diagnosis of insulin resistance remains challenging. The lack of sensitivity and specificity of traditional methods such as fasting insulin, assessment of insulin resistance using homeostasis models, and oral glucose tolerance testing demonstrates the need for more efficient diagnostic methods. Recent advances in screening technology such as use newly discovered biomarkers which are based on the highly advanced technology associated with liquid chromatography coupled with mass spectrometry (LC- MS/MS), used to detect and characterize biomolecules in complex matrices at high levels of sensitivity and selectivity and genetic markers to assess insulin sensitivity and identify people at increased risk for heart problems.

Advanced omics technologies, including genomics, transcriptomics, proteomics, and metabolomics, can provide insights into the molecular pathways of insulin resistance and cardiovascular disease, facilitating the discovery of new approaches to risk stratification and personalized interventions. Noninvasive imaging techniques such as magnetic resonance imaging, computed tomography, and positron emission tomography can provide important information about adipose tissue distribution, hyperlipid content, and myocardial perfusion. It also helps in early detection of insulin resistance and subclinical symptoms of heart disease.

Insulin resistance plays a significant role in the development of cardiovascular diseases, contributing to lipid dysregulation, inflammation, oxidative stress, and endothelial dysfunction. Targeted therapeutic interventions to improve insulin sensitivity may offer hope for reducing the burden of cardiovascular diseases in people with insulin resistance. Further research is needed to elucidate the complex interplay between insulin signaling pathways and cardiovascular health.