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DIABETIC ANGIOPATHY AND MECHANISMS OF ISCHEMIC HEART DISEASE DEVELOPMENT IN TYPE 2 DIABETES MELLITUS

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Abstract

Type 2 diabetes mellitus (T2DM) is one of the most common chronic metabolic disorders associated with severe cardiovascular complications. Among these complications, diabetic angiopathy and ischemic heart disease (IHD) occupy a leading position in morbidity and mortality worldwide. Chronic hyperglycemia contributes to vascular endothelial damage, oxidative stress, inflammation, and accelerated atherosclerosis, all of which play critical roles in the pathogenesis of coronary artery disease. Diabetic angiopathy affects both microvascular and macrovascular circulation, leading to impaired myocardial perfusion and increased risk of ischemic events. This article discusses the major pathogenic mechanisms linking diabetic angiopathy with the development of ischemic heart disease in patients with type 2 diabetes mellitus. Understanding these mechanisms is essential for early diagnosis, prevention, and effective therapeutic strategies aimed at reducing cardiovascular complications in diabetic patients.

Keywords

Type 2 diabetes mellitus, diabetic angiopathy, ischemic heart disease, endothelial dysfunction, atherosclerosis, hyperglycemia, cardiovascular complications, oxidative stress, insulin resistance.

Introduction

Type 2 diabetes mellitus is a progressive metabolic disease characterized by chronic hyperglycemia caused by insulin resistance and impaired insulin secretion. The prevalence of T2DM has increased dramatically over recent decades due to sedentary lifestyle, obesity, and population aging. Cardiovascular diseases remain the primary cause of death among diabetic patients, and ischemic heart disease is considered the most common cardiovascular complication.

Diabetic angiopathy represents one of the major pathological consequences of long-term diabetes mellitus. It includes both microangiopathy and macroangiopathy affecting blood vessels throughout the body. Coronary artery involvement leads to impaired myocardial blood supply and contributes significantly to the development of ischemic heart disease.

Patients with type 2 diabetes have a two- to fourfold higher risk of developing coronary artery disease compared with non-diabetic individuals. Furthermore, diabetic patients often develop diffuse and multi-vessel coronary lesions associated with poor clinical outcomes and increased mortality.

The pathogenesis of diabetic angiopathy and ischemic heart disease is multifactorial and involves metabolic, vascular, inflammatory, and neurohormonal disturbances. Early recognition of these mechanisms is crucial for preventing severe cardiovascular complications.

Materials and Methods

This article is based on a comprehensive review and analysis of modern scientific literature related to diabetic angiopathy and ischemic heart disease in patients with type 2 diabetes mellitus.

Scientific articles, clinical guidelines, and epidemiological studies published in international medical journals were analyzed. The review focused on the following aspects:

- Pathophysiology of diabetic angiopathy
- Endothelial dysfunction in diabetes
- Mechanisms of atherosclerosis progression
- Role of oxidative stress and inflammation
- Clinical relationship between diabetes and ischemic heart disease

Results

Endothelial Dysfunction

One of the earliest mechanisms involved in diabetic angiopathy is endothelial dysfunction. Chronic hyperglycemia damages endothelial cells and reduces nitric oxide production, leading to impaired vasodilation and vascular stiffness.

Oxidative Stress

Persistent hyperglycemia increases the production of reactive oxygen species (ROS), resulting in oxidative stress. Oxidative stress damages vascular structures and accelerates atherosclerotic plaque formation.

Chronic Inflammation

Type 2 diabetes is associated with chronic low-grade inflammation. Elevated inflammatory cytokines contribute to vascular injury, plaque instability, and progression of coronary artery disease.

Insulin Resistance

Insulin resistance alters lipid metabolism and promotes dyslipidemia. Elevated LDL cholesterol and triglycerides accelerate atherosclerosis and increase cardiovascular risk.

Diabetic Macroangiopathy

Macrovascular complications involve large and medium-sized arteries, particularly coronary arteries. Progressive narrowing of coronary vessels reduces myocardial blood flow and leads to ischemia.

Microvascular Dysfunction

Microangiopathy impairs capillary circulation and myocardial perfusion even in the absence of significant coronary artery stenosis. This contributes to silent myocardial ischemia frequently observed in diabetic patients.

Discussion

The relationship between diabetic angiopathy and ischemic heart disease is complex and closely interconnected. Hyperglycemia acts as the primary initiating factor leading to endothelial injury and vascular dysfunction.

Advanced glycation end products (AGEs) accumulate in vascular tissues and promote inflammation, fibrosis, and arterial stiffness. These pathological changes accelerate atherosclerotic processes and worsen coronary circulation.

Another important mechanism is diabetic autonomic neuropathy, which reduces pain sensitivity and often masks classical symptoms of myocardial ischemia. As a result, many diabetic patients develop silent ischemia and late-stage coronary artery disease.

Insulin resistance and associated metabolic syndrome further aggravate cardiovascular damage. Hypertension, obesity, and dyslipidemia commonly coexist in diabetic patients and synergistically increase the risk of ischemic heart disease.

Clinical studies demonstrate that diabetic patients exhibit more severe and diffuse coronary lesions compared to non-diabetic individuals. These vascular changes are associated with increased rates of myocardial infarction, heart failure, arrhythmias, and cardiovascular mortality.

Early detection of vascular abnormalities and aggressive control of metabolic risk factors are essential for preventing progression of ischemic heart disease in patients with type 2 diabetes mellitus.

Conclusion

Diabetic angiopathy plays a central role in the development of ischemic heart disease in patients with type 2 diabetes mellitus. Chronic hyperglycemia, endothelial dysfunction, oxidative stress, inflammation, and insulin resistance collectively contribute to vascular damage and coronary artery disease progression.

The coexistence of diabetes and ischemic heart disease significantly worsens prognosis and increases cardiovascular mortality. Comprehensive management strategies including strict glycemic control, lipid regulation, blood pressure management, and lifestyle modification are necessary to reduce cardiovascular risk.

Further research is required to develop novel therapeutic approaches targeting vascular protection and early prevention of diabetic cardiovascular complications.

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