Emerging Trends in Peripheral Artery Disease: A Review of Recent Studies

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Abstract

Background. Peripheral artery disease (PAD) is a chronic vascular condition characterized by the narrowing or blockage of peripheral arteries, primarily affecting the lower extremities. It is a major manifestation of atherosclerosis and a significant contributor to cardiovascular morbidity and mortality worldwide. The disease disproportionately affects older adults, smokers, individuals with diabetes, and those with a history of hypertension or hyperlipidemia.

Methods. Existing scholarly work was explored through PubMed, Elsevier, Google Scholar, and Scopus, using relevant keywords, such as "peripheral artery disease," "diabetes," "atherosclerosis," and "short-chain fatty acids."

Discussion. The global burden of PAD has risen, driven by aging populations and increasing prevalence of risk factors. Advances in diagnostic techniques, medical therapies, and interventional approaches have expanded treatment options, but challenges persist in ensuring early detection, equitable access, and effective long-term management. This review aims to synthesize the latest literature on PAD, emphasizing recent developments and identifying gaps that warrant further exploration.

Conclusion. The objective of this review is to synthesize recent advancements in our understanding, diagnosis and management of peripheral artery disease (PAD). Peripheral Arterial Disease is a chronic, progressive vascular disorder with significant global health implications. The paper examines the complex relationship between PAD and type 2 diabetes mellitus (T2DM), a prevalent comorbidity linked to increased disease severity and unfavorable outcomes due to shared pathological mechanisms such as endothelial dysfunction, chronic

inflammation, and atherosclerosis. Furthermore, it explores emerging treatment strategies, including novel pharmacological agents and innovative therapeutic technologies aimed at enhancing perfusion and mitigating disease progression.

Keywords: Peripheral artery disease, diabetes, atherosclerosis, endovascular treatment, short-chain fatty acids, glucose control

Introduction

Peripheral artery disease is an all-encompassing term used to describe disorders of the structure (including stenosis and aneurysms) and function of all non-coronary arteries. [1] Peripheral artery disorders include atherosclerosis, plaque rupture, abnormal vascular reactivity, vasospasm, inflammation, arterial wall dysplasia, and thrombus formation leading to occlusion. In the past, a range of other terms have been used, including peripheral vascular disease (PVD), peripheral artery occlusive disease (PAOD), lower extremity arterial disease (LEAD), and arteriosclerosis obliterans.[2] A variety of clinical manifestations can be observed in peripheral artery disease (PAD), and this paper focuses on the most prevalent form of PAD: atherosclerosis and its relationship with the development of diabetes mellitus. Recent research has expanded our understanding of Peripheral Artery Disease cause, symptoms, and factors, particularly regarding its relationship with diabetes, advancements in treatment modalities, and underlying risk factors. This review consolidates findings from recent literature to offer a comprehensive perspective on Peripheral Artery Disease and its management.

Methods

This review was conducted by systematically searching peer-reviewed literature on Peripheral Artery Disease (PAD) published in the past five years (2019–2024). Major electronic databases, including PubMed, Scopus, and Web of Science, were queried using a combination of relevant keywords and Medical Subject Headings (MeSH) terms such as "Peripheral Artery Disease," "atherosclerosis," "type 2 diabetes," "endovascular therapy," and "risk factors." Articles were selected based on their relevance, quality, and focus on recent advancements in the understanding, diagnosis, and treatment of PAD. The review process involved a comprehensive analysis of the selected articles to identify emerging trends, novel diagnostic and therapeutic approaches, and gaps in the literature. A narrative synthesis was employed to integrate findings and provide a cohesive overview of the current state of PAD research developments and management.

Results

Recent advancements in Peripheral Artery Disease (PAD) management emphasize improved diagnostics, innovative treatments, and a multidisciplinary care approach. New diagnostic tools and imaging methods enhance early detection of PAD, crucial for preventing severe complications. Furthermore, structured exercise programs, either supervised or community-based, continue to show significant benefits in improving patient mobility and quality of life. Updated clinical guidelines now stress the importance of a patient-centered, collaborative care model, which has been proven to improve long-term outcomes for PAD patients.

Discussion

Overview of Peripheral Artery Disease

Peripheral arterial disease (PAD) is a circulatory condition characterized by reduced blood flow through the arteries, primarily affecting the extremities. This often leads to symptoms such as thigh or calf pain during physical activity or walking. This discussion focuses on the assessment and treatment of PAD while highlighting the importance of an interprofessional team approach to enhance patient outcomes and overall care.[1]

Etiology

Peripheral artery disease is typically caused by atherosclerosis. However, other potential etiological factors include inflammation of the vasculature, trauma, and radiation exposure. Additional risk factors include diabetes, smoking, obesity, high blood pressure and cholesterol, advancing age, family history and other factors.[1]

Epidemiology

Peripheral artery disease (PAD) affects over 200 million adults worldwide, with the incidence of PAD increasing to as high as 20% in individuals over the age of 70. [1] The risk of developing PAD is increased fourfold by smoking, with the greatest impact on disease severity. In comparison to non-smokers, smokers with peripheral artery disease (PAD) have a reduced life expectancy and a higher incidence of critical limb ischemia and amputation.[2]

Pathophysiology

Peripheral arterial disease (PAD) typically manifests as an atherosclerotic disease affecting the abdominal aorta, iliac arteries, and femoral arteries. The pathophysiology of atherosclerosis is characterized by a complex interplay between cholesterol and blood vessel cells. The most

severe cases may result in the discoloration and gangrene of the toes or the entire forefoot due to the development of ischemic necrosis.[1]

Evaluation

The management of PAD differs based on the severity of the disease and the status of symptoms. The authors emphasize the importance of early detection and the role of a variety of imaging modalities in diagnosing PAD. [1]

Diabetes and Peripheral Artery Disease

The intersection of diabetes and PAD in the review, "Diabetes and Peripheral Artery Disease: A Review," published in World Journal of Diabetes. The article examines how diabetes exacerbates PAD, contributing to increased morbidity and complexity in management. The review highlights the need for integrated care approaches to address both conditions simultaneously.[3]

The Relationship Between Risk Factors for Peripheral Artery Disease (PAD) and Diabetes

The major risk factors for peripheral artery disease (PAD), such as diabetes, smoking, hypertension, and high cholesterol, also contribute to the development of coronary heart disease and cerebrovascular disease, though the extent of their impact varies.[3] A review of the literature indicates that diabetes is a significant risk factor for PAD, second only to smoking in its contribution to complications such as lower extremity amputation, prolonged hospitalizations, and mortality. Further diabetes-related risk factors include elevated blood sugar levels and abdominal obesity.

Peripheral artery disease (PAD) as a complication of diabetes

The primary concern in peripheral artery disease (PAD) in individuals with diabetes is the development of atherosclerosis, which initiates with the formation of atheromas and ultimately results in obstructed blood flow. This process, referred to as subclinical atherosclerosis, has the potential to commence prior to the diagnosis of diabetes. Atherosclerosis is initiated by a number of factors, including endothelial dysfunction, inflammation, and abnormalities in vascular smooth muscle cells.[5-7]

Comprehensive Review of Peripheral Artery Disease

A detailed analysis of PAD in the article, "Peripheral Artery Disease: A Comprehensive Updated Review," published in Current Problems in Cardiology. The review covers recent developments in PAD research, including risk factors, novel diagnostic methods, and treatment options.[4] The authors stress the importance of updated clinical guidelines and research in improving patient outcomes.

Treatment

The aim of PAD management is to reduce the risk of cardiovascular disease and to improve the ability to walk. All patients with PAD, regardless of whether they are symptomatic, are at an increased risk of stroke, myocardial infarction, and thrombosis, which contribute to a shorter life expectancy.[1] Lifestyle modifications, including cessation of smoking, reduction of cholesterol, and management of hypertension and diabetes, are crucial for reducing these risks.

Management of PAD

Peripheral Artery Disease should be managed with ABI and conservative treatment. The Ankle-Brachial Index (ABI) helps identify people with PAD. The ABI (Ankle-Brachial Index) test is the initial diagnostic tool for peripheral artery disease (PAD). It assesses the systolic pressure in the arms relative to that in the ankles. This test is commonly performed on individuals with diabetes, heavy smokers, and those with kidney failure.[1] Treating PAD starts with lifestyle changes to lower cardiovascular risk. These include quitting smoking, exercise, and diet changes.[2]

Short-Chain Fatty Acids and PAD

Investigation was performed on the role of short-chain fatty acids (SCFAs) in PAD in the study, "The Correlation of Short-Chain Fatty Acids with Peripheral Arterial Disease in Diabetes Mellitus Patients," published in Life. The research suggests that SCFAs may influence PAD progression in diabetic patients, highlighting a potential area for therapeutic intervention [5]

Advances in Endovascular Treatment

Recent review advancements in endovascular treatments for PAD in their article, "Recent advances in endovascular treatment of peripheral arterial disease," published in F1000Research. The review discusses innovative techniques and technologies that have improved treatment efficacy and patient outcomes in PAD management.[6]

Glucose Control and Survival Benefit

Examination on the impact of glucose control on PAD outcomes in the study, "Peripheral arterial disease and type 2 diabetes: Older patients still exhibit a survival benefit from glucose control," published in Diabetes and Vascular Disease Research. The authors conclude that maintaining glucose control can significantly benefit older patients with PAD, reinforcing the importance of metabolic management.[7]

PAD as a Silent Killer

The critical nature of PAD in their article, "Peripheral Artery Disease: The New and Old Silent Killer," published in Journal of the American College of Cardiology. The review highlights the often-underestimated impact of PAD on cardiovascular health and stresses the need for increased awareness and proactive management strategies.[8]

Diabetes correlation to PAD severity

The journal "Diabetes Mellitus in Peripheral Artery Disease: Beyond a Risk Factor" explores the complex relationship between diabetes mellitus (DM) and peripheral artery disease (PAD), focusing on how diabetes worsens PAD outcomes. While diabetes is a major risk factor for PAD, it also significantly impacts the severity of the disease, leading to higher risks of complications like critical limb-threatening ischemia (CLTI) and limb amputation. The review highlights how diabetes impairs vascular repair mechanisms, such as arteriogenesis and angiogenesis, through metabolic abnormalities, inflammation, and oxidative stress. It also discusses the negative effects on skeletal muscle, contributing to poor recovery from ischemia. Additionally, the role of microRNAs and specific genes in influencing PAD outcomes in diabetes is explored, suggesting potential therapeutic targets for improving recovery and treatment of PAD in diabetic patients.[9,10]

Conclusion

The reviewed literature underscores the multifaceted nature of PAD and its management. The intersection of PAD and diabetes presents significant challenges, necessitating integrated care strategies. Advances in endovascular treatment and the potential role of SCFAs highlight evolving therapeutic options. Additionally, glucose control remains a crucial factor in improving patient outcomes, particularly in older populations. The call for increased awareness and proactive management reflects a broader need for comprehensive approaches in PAD care. Recent advancements in the understanding and treatment of Peripheral Artery Disease offer

new insights into managing this complex condition. The integration of findings from genetic, metabolic, and therapeutic research underscores the importance of a holistic approach to PAD. Continued research and clinical innovation are essential to enhancing patient outcomes and addressing the ongoing challenges associated with PAD.

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