Mini Review
Volume 13:02, 2024

Journal of Hypertension: Open Access

ISSN: 2167-1095 Open Access

Exploring Gene Therapy's Evolution in Addressing Hypertension, Atherosclerosis and Familial Hypercholesterolemia

Chayanika Abikasilutame*

Department of Medicine, University of Palermo, 90127 Palermo, Italy

Abstract

Gene therapy has emerged as a promising approach for addressing cardiovascular diseases such as hypertension, atherosclerosis and Familial Hypercholesterolemia (FH). This review explores the evolution of gene therapy techniques and their applications in the management of these cardiovascular conditions. We discuss the underlying molecular mechanisms, delivery methods and therapeutic targets utilized in gene therapy interventions for hypertension, atherosclerosis and FH. Furthermore, we highlight recent advancements, challenges and future directions in the field of cardiovascular gene therapy, with the potential to revolutionize the treatment of these prevalent and debilitating conditions.

Keywords: Gene therapy • Atherosclerosis • Familial hypercholesterolemia • Cardiovascular diseases

Introduction

Cardiovascular diseases, including hypertension, atherosclerosis and Familial Hypercholesterolemia (FH), represent leading causes of morbidity and mortality worldwide. Despite significant advances in pharmacological and interventional therapies, the management of these conditions remains challenging, necessitating the exploration of novel treatment modalities such as gene therapy. Gene therapy involves the delivery of therapeutic genes or nucleic acids to target cells, with the aim of modulating specific molecular pathways implicated in disease pathogenesis. In the context of hypertension, gene therapy strategies may target key regulators of blood pressure, such as the Renin-Angiotensin-Aldosterone System (RAAS) or endothelial Nitric Oxide Synthase (eNOS), to achieve sustained reductions in blood pressure and mitigate end-organ damage. Atherosclerosis, characterized by the accumulation of lipid-rich plaques in arterial walls, represents a major contributor to cardiovascular morbidity and mortality. Gene therapy approaches for atherosclerosis aim to modulate lipid metabolism, inflammation and plaque stability through the delivery of genes encoding anti-inflammatory cytokines, lipid-modifying enzymes, or Vascular Endothelial Growth Factors (VEGF), promoting plaque regression and stabilization. FH is a hereditary lipid disorder characterized by elevated levels of Low-Density Lipoprotein Cholesterol (LDL-C), leading to premature atherosclerosis and cardiovascular events. Gene therapy strategies for FH typically involve the delivery of genes encoding LDL Receptor (LDLR) or LDLR-Related Protein (LRP), aiming to enhance LDL clearance from circulation and reduce atherosclerotic burden [1].

The evolution of gene therapy techniques, including viral and non-viral vectors, genome editing technologies and targeted delivery systems, has facilitated the development of innovative treatments for hypertension, atherosclerosis and FH. Recent preclinical and clinical studies have demonstrated the feasibility, safety and efficacy of gene therapy interventions in animal models and human subjects, underscoring the potential of this approach to revolutionize cardiovascular medicine. Despite these advancements, several challenges remain to be addressed in the field of cardiovascular gene therapy, including vector immunogenicity, off-target effects and long-term safety and efficacy. Furthermore, the translation of preclinical findings into clinically viable therapies requires rigorous preclinical testing, optimization of delivery methods and regulatory approval processes. In this review, we aim to provide a comprehensive overview of gene therapy's evolution in addressing hypertension, atherosclerosis and FH. We will discuss the underlying molecular mechanisms, delivery methods, therapeutic targets, recent advancements, challenges and future directions in the field of cardiovascular gene therapy, highlighting its potential to transform the treatment landscape for these prevalent and debilitating conditions [2,3].

Literature Review

The literature on gene therapy for hypertension, atherosclerosis and Familial Hypercholesterolemia (FH) spans several decades and encompasses a wide range of experimental and clinical studies. Early research focused on elucidating the molecular mechanisms underlying these cardiovascular conditions and identifying potential therapeutic targets for gene-based interventions. Studies investigating hypertension have identified key regulators of blood pressure homeostasis, including components of the Renin-Angiotensin-Aldosterone System (RAAS), endothelial Nitric Oxide Synthase (eNOS) and vascular smooth muscle cell function. Gene therapy approaches targeting these pathways have shown promise in preclinical models of hypertension, with some studies demonstrating sustained reductions in blood pressure and attenuation of end-organ damage [4]. Atherosclerosis research has elucidated the complex interplay between lipid metabolism, inflammation and endothelial dysfunction in the development and progression of atherosclerotic plaques. Gene therapy strategies aimed at modulating these pathways have been investigated in animal models of atherosclerosis, with promising results in terms of plaque regression, stabilization and improvement in vascular function. In the context of FH, studies have focused on enhancing Low-Density Lipoprotein Receptor (LDLR) expression or function to promote clearance of circulating LDL cholesterol and reduce atherosclerotic burden. Gene therapy approaches involving the delivery of LDLR or LDLR-Related Protein (LRP) genes have shown efficacy in preclinical models of FH, offering the potential for long-term LDL cholesterol reduction and cardiovascular risk reduction [5].

***Address for Correspondence:** Chayanika Abikasilutame, Department of Medicine, University of Palermo, 90127 Palermo, Italy, E-mail: chayanikaabikasilutame@hotmail.com*

Received: 01 April, 2024, Manuscript No. jhoa-24-135060; **Editor Assigned:** 03 April, 2024, PreQC No. P-135060; **Reviewed:** 15 April, 2024, QC No. Q-135060; **Revised:** 20 April, 2024, Manuscript No. R-135060; **Published:** 27 April, 2024, DOI: 10.37421/2167-1095.2024.13.451

Discussion

Gene therapy holds significant promise for the treatment of hypertension, atherosclerosis and FH, offering the potential for targeted, long-term therapeutic effects. By modulating specific molecular pathways implicated in disease pathogenesis, gene-based interventions have the potential to address underlying disease mechanisms and provide sustained improvements in cardiovascular outcomes. However, several challenges and limitations must be addressed to realize the full potential of gene therapy in cardiovascular medicine. Delivery remains a key obstacle, as efficient and targeted delivery of therapeutic genes to the appropriate tissues and cells within the cardiovascular system remains challenging. Additionally, concerns regarding vector immunogenicity, off-target effects and long-term safety and efficacy need to be addressed through rigorous preclinical testing and clinical trials. Despite these challenges, recent advancements in gene therapy vectors, delivery systems and genome editing technologies offer new opportunities for overcoming existing limitations and advancing the field of cardiovascular gene therapy. Collaborative efforts between researchers, clinicians and industry partners are essential for translating preclinical findings into clinically viable therapies and addressing the unmet needs of patients with hypertension, atherosclerosis and FH [6].

Conclusion

In conclusion, gene therapy represents a promising therapeutic approach for addressing hypertension, atherosclerosis and FH. By targeting specific molecular pathways implicated in disease pathogenesis, gene-based interventions offer the potential for sustained improvements in cardiovascular outcomes and reduced morbidity and mortality associated with these conditions. Despite remaining challenges and limitations, ongoing advancements in gene therapy vectors, delivery systems and genome editing technologies hold promise for revolutionizing the treatment landscape for patients with cardiovascular diseases. Collaborative research efforts and clinical trials are needed to further elucidate the safety and efficacy of gene therapy interventions and accelerate their translation into clinical practice.

Acknowledgment

None.

Conflict of Interest

No conflict of interest.

References

1. Kovacic, Sanja and Mirjana Bakran. "Genetic susceptibility to atherosclerosis." *Stroke Res Treat* 2012 (2012).
2. Cao, Genmao, Xuezhen Xuan, Ruijing Zhang and Jie Hu, et al. "Gene therapy for cardiovascular disease: Basic research and clinical prospects." *Front Cardiovasc Med* 8 (2021): 760140.
3. Wu, Chia-Hua, Shayan Mohammadmoradi, Jeff Z. Chen and Hisashi Sawada, et al. "Renin-angiotensin system and cardiovascular functions." *Arterioscler Thromb Vasc Biol* 38 (2018): e108-e116.
4. Sequeira-Lopez, Maria Luisa S. and R. Ariel Gomez. "Renin cells, the kidney and hypertension." *Circ Res* 128 (2021): 887-907.
5. Benetos, Athanase, Sylvie Gautier, Sylvain Ricard and Jirar Topouchian, et al. "Influence of angiotensin-converting enzyme and angiotensin II type 1 receptor gene polymorphisms on aortic stiffness in normotensive and hypertensive patients." *Circulation* 94 (1996): 698-703.
6. Danigo, Aurore, Amandine Rovini, Flavien Bessaguet and Hichem Bouchenaki, et al. "The angiotensin II type 2 receptor, a target for protection and regeneration of the peripheral nervous system?." *Pharmaceuticals* 14 (2021): 175.

How to cite this article: Abikasilutame, Chayanika. "Exploring Gene Therapy's Evolution in Addressing Hypertension, Atherosclerosis and Familial Hypercholesterolemia." *J Hypertens* 13 (2024): 451.