Short Communication

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The Role of MicroRNAs in regulating genes related to neurodegenerative diseases

Abstract

Neurodegenerative diseases pose significant challenges to public health worldwide. MicroRNAs (miRNAs) have emerged as critical regulators of gene expression and are implicated in the pathogenesis of various neurodegenerative disorders. This review comprehensively explores the current understanding of how miRNAs influence gene networks involved in Alzheimer disease, Parkinson disease and amyotrophic lateral sclerosis. We discuss the mechanisms by which miRNAs modulate disease associated genes, their potential as diagnostic biomarkers, and therapeutic targets in neurodegeneration.

Keywords: microRNA, neurodegenerative diseases, Alzheimer disease, parkinson disease, amyotrophic lateral sclerosis

Volume 7 Issue 1 - 2024

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Received: June 22, 2024 | **Published:** July 01, 2024

Introduction

Neurodegenerative diseases, characterized by progressive loss of neuronal function and structure, represent a growing burden on healthcare systems globally. Understanding the molecular mechanisms underlying these disorders is crucial for developing effective treatments. MicroRNAs (miRNAs), small noncoding RNAs,[1] have garnered significant attention for their regulatory roles in gene expression, influencing pathways implicated in neurodegeneration. This review aims to summarize the current literature on miRNA mediated gene regulation in Alzheimer disease (AD), Parkinson disease (PD), and amyotrophic lateral sclerosis (ALS),[2] highlighting their potential implications for disease pathogenesis and therapeutic interventions.

Materials and methods

A comprehensive literature search was conducted using electronic databases such as PubMed, Web of Science, and Scopus. Keywords included microRNA, neurodegenerative diseases, Alzheimer disease, Parkinson disease, amyotrophic lateral sclerosis, and gene regulation. Articles published within the last decade, including reviews, original research, and clinical studies, were selected for inclusion. Data were synthesized to elucidate the roles of specific miRNAs in modulating disease-related genes and pathways.

Results

MicroRNAs play diverse roles in neurodegenerative diseases by targeting key genes involved in neuronal survival, apoptosis, inflammation, and protein aggregation pathways. In AD, miRNAs such as miR-29, miR-124, and miR-132 regulate genes associated with amyloid-beta metabolism and tau protein phosphorylation. In PD, miRNAs including miR-133b, miR-7, and miR-34a modulate genes involved in alpha-synuclein aggregation and dopaminergic neuron function.[3,4] ALS is influenced by miRNAs like miR206 and miR-155, which regulate genes related to neuro inflammation and oxidative stress. Dysregulation of these miRNAs contributes to disease pathogenesis, making them potential biomarkers and therapeutic targets.[5]

Discussion

The dysregulation of miRNAs in neurodegenerative diseases reflects their multifaceted roles in pathophysiology.[6,7] Challenges include the complexity of miRNA target interactions, tissue-specific expression patterns, and variability in disease progression among patients. Advances in sequencing technologies and bioinformatics have enabled the identification of miRNA signatures associated with disease subtypes and progression stages. Therapeutic strategies targeting miRNAs, such as antisense oligonucleotides and viral vector-mediated delivery systems, hold promise for restoring miRNA homeostasis and ameliorating disease symptoms.

Conclusion

MicroRNAs represent integral components of gene regulatory networks implicated in neurodegenerative diseases.[8] Understanding their roles in disease pathogenesis offers new avenues for developing biomarkers and therapeutic interventions. Future research should focus on elucidating miRNA-target interactions, validating biomarker utility in clinical settings, and advancing miRNA-based therapies towards clinical trials.

Acknowledgments

None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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Citation: Piasentim JVC, Asseiss SN. The Role of MicroRNAs in regulating genes related to neurodegenerative diseases. *Int J Mol Biol Open Access.* 2024;7(1):81–82. DOI: 10.15406/ijmboa.2024.07.00174