

Neurodegeneration: Mechanisms, therapies, and biomarker.

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Introduction

This review focuses on current therapeutic strategies and compounds designed to combat protein aggregation, a hallmark of many neurodegenerative conditions. It details various approaches, including inhibiting protein misfolding, clearing aggregates, and modulating pathways involved in protein homeostasis[1].

This article explores mitochondrial dysfunction as a central mechanism underlying various neurodegenerative diseases. It discusses how impaired mitochondrial function leads to energy deficits, oxidative stress, and neuronal damage, proposing a unified theory for their pathogenesis and highlighting therapeutic targets[2].

This paper reviews the intricate role of neuroinflammation in the progression of neurodegenerative diseases. It delves into the diverse cellular and molecular players involved, offering new insights into potential therapeutic avenues that target inflammatory pathways to mitigate neuronal damage[3].

This review highlights the growing understanding of the gut microbiota-brain axis and its significant influence on neurodegenerative disorders. It discusses how alterations in gut microbial composition can impact brain function, inflammation, and disease progression, suggesting novel therapeutic targets[4].

This review explores the potential of exosomes as both biomarkers for early diagnosis and therapeutic delivery vehicles in neurodegenerative diseases. It summarizes recent advancements in understanding their roles in intercellular communication and their utility in clinical applications[5].

This article provides an overview of the latest developments and hurdles in gene therapy for neurodegenerative diseases. It covers various gene delivery methods and therapeutic targets, discussing the promise and limitations of this approach in addressing the underlying genetic causes of these conditions[6].

This review explores emerging diagnostic biomarkers crucial for the early detection of neurodegenerative diseases. It discusses various types of biomarkers from bodily fluids and imaging techniques, emphasizing their potential to facilitate timely intervention and im-

proved patient outcomes[7].

This update reviews therapeutic strategies focused on restoring proteostasis, the delicate balance of protein synthesis, folding, and degradation, which is often disrupted in neurodegenerative conditions. It highlights new compounds and approaches aimed at preventing protein misfolding and aggregation[8].

This article explores the application of CRISPR/Cas9 technology in understanding and potentially treating neurodegenerative diseases. It discusses the mechanisms of gene editing, its current uses in modeling diseases, and the challenges that need to be addressed for therapeutic translation[9].

This review delves into the complex bidirectional relationship between sleep disturbances and neurodegenerative diseases. It explains how poor sleep can exacerbate neurodegeneration and, conversely, how neurodegenerative processes can disrupt sleep architecture, highlighting a critical area for therapeutic intervention[10].

Conclusion

Research into neurodegenerative diseases highlights a multifaceted landscape of pathogenic mechanisms and therapeutic innovations. Major focus areas include strategies to combat protein aggregation, a common pathological feature, through inhibiting misfolding, clearing aggregates, and modulating protein homeostasis [1, 8]. Studies also underscore mitochondrial dysfunction as a central mechanism, leading to energy deficits, oxidative stress, and neuronal damage, which informs unified theories of pathogenesis and identifies crucial therapeutic targets [2]. The complex role of neuroinflammation in disease progression is also extensively reviewed, revealing diverse cellular and molecular players that offer new avenues for intervention to mitigate neuronal damage [3]. Furthermore, the influence of systemic factors like the gut microbiota-brain axis is gaining recognition, with alterations impacting brain function, inflammation, and disease trajectory [4]. The intricate, bidirectional relationship between sleep disturbances and neurodegeneration also represents a key area for therapeutic focus, as disrupted sleep can worsen conditions and vice-versa [10]. On the therapeutic front, advancements in gene therapy are explored, addressing

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genetic causes through various delivery methods and targets [6]. CRISPR/Cas9 technology is also being applied to understand and potentially treat these diseases, despite challenges in clinical translation [9]. Crucially, the development of novel diagnostic biomarkers from bodily fluids and imaging techniques is advancing, aiming for earlier detection and improved patient outcomes [7]. Exosomes are identified as particularly promising, serving as both biomarkers for early diagnosis and innovative therapeutic delivery vehicles, given their role in intercellular communication [5]. This collective research aims to provide comprehensive insights and develop more effective strategies against neurodegenerative conditions.

References

1. Nima S, Jharana K, Roshan P. Targeting Protein Aggregation in Neurodegenerative Diseases: *An Update on Strategies and Compounds*. *Biomolecules*. 2023;13:1110.
2. Sara B, Sonia S, Santiago F. Mitochondrial Dysfunction and Neurodegeneration: *The Unifying Theory*. *Cells*. 2022;11:1683.
3. Yang L, Yu X, Xiaoming Y. Neuroinflammation in neurodegenerative diseases: new perspectives for therapeutic strategies. *CNS Neurosci Ther*. 2021;27:388-398.
4. Shan L, Jie G, Min Z. The Gut Microbiota-Brain Axis and Its Effect on Neurodegenerative Diseases. *Mol Neurobiol*. 2020;57:2908-2921.
5. Chao Y, Ying L, Hui W. Exosomes as promising biomarkers and therapeutic targets for neurodegenerative diseases: *A review*. *Front Mol Neurosci*. 2024;17:1352486.
6. Yu S, Shuyun J, Chong W. Gene Therapy for Neurodegenerative Diseases: *Recent Advances and Challenges*. *Genes* (Basel). 2023;14:355.
7. Nada K, Hiba E, Dina A. Novel diagnostic biomarkers for early detection of neurodegenerative diseases. *J Clin Neurosci*. 2022;103:323-333.
8. Md. Sahab U, Md. Sarwar S, Md. Ataur R. Targeting Proteostasis for Neurodegenerative Diseases: *An Update*. *ACS Chem Neurosci*. 2021;12:799-813.
9. Zhaojia L, Haiyue X, Yan W. CRISPR/Cas9 for Neurodegenerative Diseases: Mechanisms, Applications, and Challenges. *Int J Mol Sci*. 2019;20:589.
10. Erik SM, Maninder SB, Paul N. Sleep and neurodegeneration: A two-way relationship. *Sci Transl Med*. 2020;12:eaax9520.

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