Neurobiology of Alzheimer's Disease and Emerging Therapies

Ricardo Mota*

Department of Neuroscience and Biomedical Sciences, University of Porto, Porto, Portugal

*Corresponding author: Ricardo Mota, Department of Neuroscience and Biomedical Sciences, University of Porto, Porto, Portugal; E-mail: rjdmo@gmail.com

Received date: Sep 20, 2024, Manuscript No. IPJBS-24-15329; **Editor assigned date:** Sep 23, 2024, PreQC No. IPJBS-24-15329 (PQ); **Reviewed date:** Oct 07, 2024, QC No. IPJBS-24-15329; **Revised date:** Oct 17, 2024, Manuscript No. IPJBS-24-15329 (R); **Published date:** Oct 24, 2024; Invoice No. J-15329

Citation: Mota R (2024) Neurobiology of Alzheimer's Disease and Emerging Therapies. J Biomed Sci Vol:13 No:5

Description

Alzheimer's Disease (AD) is a progressive neurodegenerative disorder characterized by cognitive decline, memory loss, and impaired daily functioning. It is the most common form of dementia, affecting millions of individuals worldwide. The neurobiology of Alzheimer's disease is complex, involving a combination of genetic, environmental, and lifestyle factors that contribute to the disease's development and progression. Recent advances in understanding the underlying mechanisms of AD have paved the way for emerging therapies aimed at slowing its progression and improving patient outcomes. This article explores the neurobiological aspects of Alzheimer's disease and highlights novel therapeutic approaches currently under investigation.

Understanding the neurobiology of Alzheimer's disease

The neurobiology of Alzheimer's disease is primarily characterized by the accumulation of two hallmark pathological features in the brain: Amyloid-Beta (A β) plaques and tau tangles. These features contribute to synaptic dysfunction, neuroinflammation, and ultimately neuronal cell death.

Amyloid-Beta plaques: A β plaques are formed by the aggregation of misfolded amyloid-beta peptides, which are cleaved from the Amyloid Precursor Protein (APP) by enzymes known as secretases. In a healthy brain, A β is cleared efficiently; however, in Alzheimer's disease, the balance shifts, leading to increased production and impaired clearance of A β . The accumulation of these plaques is believed to trigger a cascade of neurotoxic events, including synaptic dysfunction and neuroinflammation, ultimately leading to cognitive decline.

Tau tangles: Neurofibrillary tangles are intracellular aggregates of hyperphosphorylated tau protein. Tau is a microtubuleassociated protein that stabilizes the structure of neurons. In AD, abnormal phosphorylation of tau causes it to detach from microtubules and aggregate into tangles, disrupting neuronal transport and function. The presence of tau tangles correlates more closely with cognitive impairment than amyloid plaques, highlighting their significance in the disease's progression. **Neuroinflammation:** Neuroinflammation is another critical component of Alzheimer's disease pathology. Activated microglia and astrocytes, the brain's immune cells, release pro-inflammatory cytokines and reactive oxygen species in response to A β accumulation and neuronal injury. While this inflammatory response aims to protect and repair the brain, chronic neuroinflammation can exacerbate neuronal damage and contribute to disease progression.

Genetic and environmental factors

The risk of developing Alzheimer's disease is influenced by a combination of genetic and environmental factors. Several genes have been implicated in AD, with the most notable being the Apolipoprotein E (APOE) gene, specifically the APOE ϵ 4 allele. Individuals carrying this allele have an increased risk of developing Alzheimer's, as it affects the metabolism and clearance of amyloid-beta.

In addition to genetic predisposition, various environmental factors contribute to the risk of Alzheimer's disease. Lifestyle choices, such as diet, physical activity, and social engagement, play a significant role in brain health. Studies have shown that a Mediterranean diet rich in antioxidants and healthy fats can reduce the risk of cognitive decline. Furthermore, conditions such as hypertension, diabetes, and obesity are associated with an increased risk of AD, highlighting the importance of a healthy lifestyle in mitigating disease risk.

Emerging therapies for Alzheimer's disease

The increasing understanding of Alzheimer's disease neurobiology has led to the development of innovative therapeutic strategies aimed at targeting its underlying mechanisms. While no cure currently exists, several emerging therapies hold promise for slowing disease progression and improving cognitive function.

Amyloid-targeting therapies: One of the primary therapeutic approaches involves targeting amyloid-beta pathology. Several monoclonal antibodies, such as aducanumab (Aduhelm) and lecanemab (Leqembi), have been developed to promote the clearance of amyloid plaques from the brain. These antibodies work by binding to aggregated forms of A β , facilitating their removal by microglia. Clinical trials have shown that these treatments can reduce amyloid plaque levels, but their impact

ISSN 2254-609X

Vol.13 No.5:048

on clinical outcomes remains under scrutiny. The FDA's accelerated approval of aducanumab has sparked considerable debate regarding its efficacy and the need for further research.

Tau-targeting therapies: Given the critical role of tau in Alzheimer's pathology, therapies aimed at reducing tau phosphorylation and aggregation are under investigation. Tautargeting strategies include the development of small molecules that inhibit tau phosphorylation, as well as immunotherapies designed to promote the clearance of tau tangles. Preliminary studies have shown promise, but more extensive clinical trials are necessary to determine their efficacy in slowing disease progression. Alzheimer's disease represents a significant challenge in modern medicine, with its complex neurobiology influencing disease development and progression. While no cure currently exists, emerging therapies targeting amyloid-beta, tau pathology, neuroinflammation, and neuroprotection hold promise for improving patient outcomes. Additionally, lifestyle modifications play a crucial role in managing disease risk and progression. As research advances, a deeper understanding of Alzheimer's disease will pave the way for innovative treatments and strategies to enhance cognitive health and quality of life for individuals affected by this debilitating disorder.