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Review article

An optimistic approach to nanotechnology in Alzheimer's disease management: An overview

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ABSTRACT

Alzheimer's disease (AD) imparts a neurodegenerative impact on mental ability, dementia, and behavioral alterations that have been observed in the ten to twenty years before the manifestation of symptoms. The major problem lies in early diagnosis as well as management due to unavailability of authenticated biomarkers. Recent progress in nanotechnology possesses the potential to offer inexpensive screening and therapeutic solutions on a mass scale. Targeted drug delivery through nanoparticles (NPs) may efficiently cross the blood–brain barrier (BBB) with minimal adverse reactions. In addition, NPs with improved magnetic and ocular characteristics may be employed in early diagnosis. With an explicit reference to the efficacy of NP-based medicine delivery in the specific environment of the central nervous system (CNS), this technology results in early diagnosis and treatment. This review provides comprehensive information on AD and its management with special emphasis on nanotechnology advancements, nanomaterials (NMs) employed along with nanomedicines, lipid-based nanoparticles, antibody-coated nanoparticles, nanoparticle therapy, therapeutic strategies, and promising protein targets for new drug research on AD.

1. Introduction

The global prevalence of Alzheimer's disease is increasing. In 2019, more than 50 million individuals were affected by Alzheimer's disease, and the disease's burden is steadily increasing, potentially having a massive impact on both the global economy and human labor.

This number is expected to almost double in the next 20 years, from 78 to 139 million from 2030 to 2050, respectively. It is anticipated that by the middle of the twenty-first century, 13.8 million Americans aged 65 and older will have Alzheimer's disease symptoms. AD is the sixth largest cause of death in the United States, where the death rate grew to 146.2% in 2018 and 122,019 individuals died [1–3]. Memory loss, illusions, confusion, and a lack of self-sufficiency are common symptoms of Alzheimer's disease. Various markers, such as α, β-plaques, NFTs, α, β dimers, APP imbalance, gene mutations, and synaptic degradation of AD, are depicted in Fig. 1 [3,4]. Numerous conditions, such as cardiovascular problems, infections, limited oxygen supply to the brain, nutrition, vitamin B12 deficiency, malignancies, and other variables, may contribute to the progression of AD [5,6]. Notably, not only environmental and lifestyle factors but also AD commencement, age of onset, and disease advancement impact disease progression. These components may have an impact on cell differentiation, gene expression, and the pathophysiology of AD [7].

The major obstacle in AD management is the BBB. Owing to the unavailability of effective medications for AD, only supportive treatment is prescribed. However, recent advances in nanotechnology have shown promising potential for overcoming this limitation [8]. Nanotechnology is a technique for designing drugs or phytoconstituents in the

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