

## Where are we on Alzheimer's Disease?

**Alp Yigit Özdemir\***

*Department of Physiology, Charles University, Czech Republic*

**\*Corresponding Author:** Alp Yigit Özdemir, Department of Physiology, Charles University, Czech Republic.

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Alzheimer's disease is the most common type of neurological disorder called dementia and, it affects people from every gender, region, culture, ethnicity, religion, and sexual orientation. Research shows that in 2021, approximately 6 million seniors in the U.S. suffered from Alzheimer's [1, 2]. According to the World Health Organization results, Alzheimer's disease is among the top 10 diseases that cause death and has caused the death of more than 50 million people worldwide to date. Estimates predict that this number will exceed 100 million by 2050 [3]. Today, besides people diagnosed with Alzheimer's, those who must take care of these people without training and knowledge are also affected. Studies show that more than 10 million U.S. citizens care for people diagnosed with Alzheimer's without financial help. Even if these people are caring for those with Alzheimer's disease, their lack of knowledge is a significant obstacle to diagnosing, caring for and, treating it [1]. In this context, what needs to be done is to inform people about Alzheimer's disease, as well as try to find a cure for it. In addition, essential information and significant results should also be made accessible to everyone.

As is known, Alzheimer's disease is caused by the accumulation of tau tangles and Amyloid beta (A $\beta$ ) fragments inside or outside of the cells, respectively. Besides, conditions such as neural atrophies due to synaptic loss, oxidative stress and, neuroinflammation could cause neurodegeneration, and thus Alzheimer's disease [4, 5]. Even if hypotheses explain its cause based on these conditions, the exact cause of Alzheimer's disease is still not entirely understood, and its cure remains unknown. To this end, diagnostic and therapeutic studies have been continuing at full pelt using in vitro models, animal models, and clinical studies.

There are several theories according to the pathology of Alzheimer's disease. One of these theories, maybe one of the most accepted ones, is the Amyloid cascade hypothesis. A $\beta$  deposition is the leading cause of Alzheimer's pathology; due to that, the neurofibrillary tangles, loss of cells, vascular damage, and finally, dementia formed [6]. In contrast, the A $\beta$  oligomers hypothesis gradually overtakes the Amyloid cascade hypothesis. To this day, A $\beta$  oligomers are considered the most toxic form of A $\beta$  due to their morphology. In addition, the presence of these  $\beta$ -sheet rich forms of A $\beta$  has been detected in human and animal models of Alzheimer's disease [7, 8]. A $\beta$  oligomers could be identified as soluble forms of A $\beta$  aggregates. There should be equilibrium between A $\beta$  aggregates such as monomers, oligomers, and protofibrils in the brain. If this equilibrium disrupts, A $\beta$  aggregates could cause toxicity [8]. These findings suggest that the A $\beta$  oligomers hypothesis may be acceptable.

It is unclear which form of A $\beta$  oligomer is the most toxic. The latest studies show that A $\beta$  oligomer species larger than 50 kDa can be considered the most toxic forms, and specific antibodies could determine them [7, 9]. So, in the light of this knowledge, Bakrania et al. suggested that a family of antibodies could specifically bind the pseudo  $\beta$ -hairpin conformation, a structure observed in particularly toxic forms of A $\beta$  oligomers. They also suggested that this family of antibodies could be used as a vaccine against Alzheimer's disease [9]. Introducing these antibodies to the body through vaccination, training the immune system against A $\beta$  oligomers toxicity, and allowing the body to metabolize these aggregates by itself can relieve the symptoms resulting from Alzheimer's disease. As against this, this is possible only with timely diagnosis.

Clinical signs and symptoms are used to diagnose Alzheimer's disease. Procedures used to diagnose Alzheimer's or other dementias may involve neuropsychological testing, laboratory tests, and neuroimaging after a medical history and physical examination, includ-

ing a neurologic and psychiatric assessment. Besides, new technologies such as detecting the biomarkers in blood or quantifying the tau in saliva could be promising for the early diagnosis of Alzheimer's. Controversy, the debate over the determination of optimal biomarkers is still ongoing. Commonly studied markers today are not optimal in terms of usability, feasibility, availability, and cost. This situation creates an obstacle for the determined biomarkers to move to the clinical research stage [10]. For a biomarker to be significant, it should be inexpensive and non-invasive. Only in this case the said biomarker could be acceptable.

The importance of Alzheimer's disease is increasing day by day. Especially with the covid-19 pandemic, the care and treatment processes of Alzheimer's patients have become even more difficult. On the other hand, recent developments in diagnosing and treating Alzheimer's are exciting in terms of preventing it. In addition to these, we, as individuals, should increase our awareness of it. In this context, the most crucial duty of scientists and researchers is to spread this awareness to their environment and make information about Alzheimer's disease accessible to people of all education levels.

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