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Article

Causes, Symptoms and Treatments of Alzheimer's Disease

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Abstract: This article provides a detailed description of the causes, main clinical symptoms and treatment methods of Alzheimer's disease. It is shown that the disease, as a neurodegenerative process, is associated with the accumulation of β-amyloid protein in the brain, disruption of connections between neurons and a decrease in the activity of the cholinergic system. Also, in the early stages of the disease, memory and thinking speed decline, decreased independence in daily activities and changes in personal behavior are noted as important symptoms. The article analyzes the role of currently used drugs (cholinesterase inhibitors, NMDA-receptor antagonists), a healthy lifestyle, diet and early diagnosis in slowing down the progression of the disease. In conclusion, although Alzheimer's disease is of great socio-medical importance, it is noted that scientific research aimed at controlling and alleviating its course is promising.

Keywords: Alzheimer's disease, dementia, neurodegenerative disease, beta-amyloid, tau protein, memory impairment, cognitive dysfunction, diagnostics, diet and healthy lifestyle, prevention, risk factors, genetics.

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1. Introduction

Alzheimer's disease is the most common form of dementia, a neurodegenerative disease first described in 1907 by German psychiatrist Alois Alzheimer. It occurs in people over the age of 65. In 2006, 26.6 million people were affected globally, and the number of patients is expected to quadruple by 2050. Alzheimer's disease is the most common cause of dementia. Alzheimer's disease is a biological process that begins with the accumulation of proteins in the brain in the form of amyloid plaques and neurofibrillary tangles. Over time, this leads to the death of brain cells and the shrinkage of the brain. Early symptoms of Alzheimer's disease include forgetting recent events or conversations. Over time, Alzheimer's disease causes severe memory loss and affects a person's ability to perform daily tasks [1], [2], [3].

There is no cure for Alzheimer's disease. In advanced stages, loss of brain function can lead to dehydration, malnutrition, or infection. These complications can be fatal. However, medications can improve symptoms or slow the decline in thinking. Programs and services can help people with the disease and their caregivers [4], [5].

2. Materials and Methods

In the process of preparing this scientific article, the existing scientific literature on Alzheimer's disease, medical textbooks, scientific articles and clinical studies conducted in recent years were thoroughly studied and analyzed. The study used analytical, comparative and modern computer-based scientific methods. The goal was to identify the

most effective and practically significant diagnostic and assessment methods for diagnosing Alzheimer's disease. The main approach to diagnosing Alzheimer's disease is based on neuropsychological and neuroimaging methods. Neuropsychological tests, including MMSE (Mini-Mental State Examination) and ADAS-Cog (Alzheimer's Disease Assessment Scale-Cognitive) allows you to determine the patient's memory, thinking and cognitive functions [6]. Neuroimaging examinations are used as the main diagnostic tool. The most commonly used of them are magnetic resonance imaging (MRI) and computed tomography (CT). These methods reveal pathological changes in the structure of the brain, including a decrease in the volume of the hippocampus and prefrontal cortex, disruption of neuronal connections, as well as the accumulation of β-amyloid and tau plaques. The MRI method shows changes even in the early stages of the disease, increasing the accuracy of the diagnosis. In addition, biochemical analyzes measure the level of tau proteins and β-amyloid in the cerebrospinal fluid (CSF) and blood plasma. This method allows you to determine the degree of neurodegenerative processes in Alzheimer's disease and differentiate the type of disease. Electroencephalography (EEG) is used as an auxiliary diagnostic method [6]. EEG detects bioelectrical changes in brain activity and assesses the functional impact of the disease. In general, a comprehensive approach is used to diagnose Alzheimer's disease, which includes laboratory, instrumental and scientific and medical methods based on modern computer technologies. This approach is highly effective in accurately assessing the patient's cognitive status, determining the stage of the disease and determining a treatment strategy.

3.

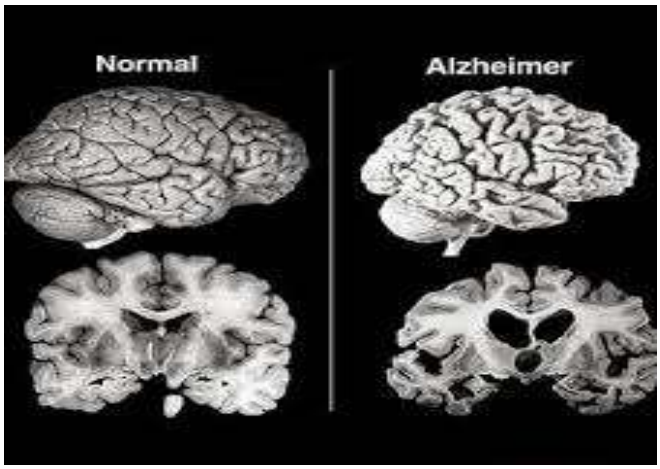

Figure 1. Alzheimer's disease seen on MRI [7]

4. Results

The onset of the disease is slow or insidious, often difficult for patients and their families to accurately diagnose. It is more common in people over 70 years of age (the average age of onset is 73 years for men and 75 years for women). In some cases, symptoms appear quickly after physical illness, fractures, or psychological stress. The disease is more common in women (3:1 compared to men). The main symptoms are: a gradual decline in cognitive function, psychiatric symptoms, behavioral disorders, and a gradual loss of daily living skills. Depending on the deterioration of cognitive abilities and physical functions, the development is divided into three stages:

5. Discussion

Mild stage of dementia (1-3 years). Symptoms include memory loss, especially for recent events; decreased judgment, difficulty analyzing, thinking, and solving complex problems; carelessness at work or at home, inability to handle shopping or financial matters independently, and social difficulties. Although the patient may still be able to perform familiar daily tasks, they struggle with new activities, exhibit emotional apathy, occasional agitation, and are often suspicious. There is also a struggle with time

orientation and difficulty understanding geographic location. Limited vocabulary and naming difficulties are also common.

The middle stage of dementia (2-10 years). Symptoms include severe impairment of short-term and long-term memory, decreased visual-spatial skills for simple structures, and difficulty in orienting to time and place. Patients have difficulty solving problems, distinguishing similarities and differences between objects, and rely on assistance with outdoor activities, dressing, personal hygiene, and grooming. They lose the ability to perform calculations and exhibit a variety of neurological symptoms, including aphasia, apraxia, and agnosia. Emotional apathy progresses to restlessness, constant wandering, and inattention.

Severe stage of dementia (8-12 years). Patients become completely dependent on caregivers and experience profound memory loss, with only fragments of memory remaining. They become unable to manage activities of daily living and experience loss of bowel and bladder control. They may exhibit stupor, rigidity, and physical examination may show positive signs of pyramidal tract damage, with primitive reflexes such as strong grasping, palpation, and sucking. Eventually, they may fall into a coma and are usually susceptible to complications such as infections [8], [9].

Although the causes of Alzheimer's disease are not fully understood , scientific research suggests that the disease is caused by complex biochemical and genetic changes in the brain. It is mainly explained by three main theories: the cholinergic hypothesis, the amyloid (genetic) theory, and the tau protein theory.

The causes of Alzheimer's disease are related to metabolic disorders in the brain. There are three main theories:

1. **Cholinergic hypothesis: A decrease in acetylcholine** may lead to inflammation and the formation of amyloid plaques.
2. **Genetic theory: the** formation of amyloid plaques is associated with genetic factors.
3. **Tau theory:** Abnormalities in the tau protein disrupt nerve impulse transmission and lead to the formation of neurofibrillary tangles. These changes lead to progressive destruction of neurons and impaired brain function. Hereditary factors play a role in less than 10% of cases.

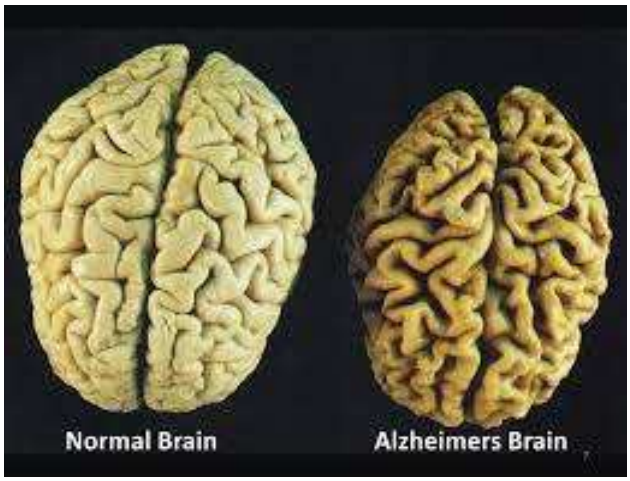

Figure 2. A healthy brain and a brain affected by Alzheimer's disease [10]

Alzheimer's disease is a slowly progressive neurodegenerative disease characterized by cognitive, behavioral, and neurological impairment.

1. Cognitive impairment. Short-term memory impairment: difficulty remembering recent events , memory of the distant past is preserved. Decreased attention and thinking: impaired ability to plan and solve problems. Speech and language

impairment: difficulty finding words, difficulty constructing sentences. Impaired ability to perform movements: inability to perform simple actions[11-12].

2. Behavioral and emotional changes. Mental apathy, frequent mood swings. Depression, anxiety, anger, suspicion or paranoia. Sometimes hallucinations (visual or auditory illusions).
3. Neurological symptoms: impaired coordination of movements. Weakened visual and auditory reflexes. Impaired swallowing reflex, decreased muscle tone.
4. Vegetative and general signs
   a) Sleep disturbance, restlessness at night.
   b) Decreased appetite, weight loss.
   c) Inability to control urine and bowels.
   d) Loss of speech and bed rest (late stage of the disease).
5. Severity of the disease. Alzheimer's disease is divided into three stages in clinical practice:
   a) Mild (Early stage): Short-term memory and attention are impaired, the patient is partially able to perform daily activities.
   b) Moderate (Intermediate stage): speech, behavior, and the ability to perform daily tasks are significantly impaired.
   c) Severe (End Stage): The patient requires full care, memory and cognitive functions are almost completely lost.

Diagnosis of Alzheimer's disease requires a comprehensive approach. This includes clinical evaluation, laboratory and neuroimaging methods .

1. Neuropsychological tests. Mini-Mental State Examination (MMSE): assesses short-term memory, attention, language, and visuospatial abilities. Scores depend on educational level: a low score indicates the presence of cognitive impairment.

ADAS-cog : Used in clinical trials to detect changes in cognitive levels in Alzheimer's disease.

2. Hematological and laboratory tests. Blood, blood sugar, electrolytes, vitamin B12, folic acid, liver and kidney function are checked. Serological tests (e.g. syphilis, HIV, Borrelia burgdorferi) are used in high-risk groups or patients with clinical symptoms.
3. Neuroimaging.
   a) Structural examinations: MRI and CT scan reveal hippocampal and medial temporal lobe atrophy, ruling out other diseases.
   b) Functional tests: PET and SPECT identify Alzheimer's-specific changes by assessing glucose metabolism and turnover.
   c) Amyloid PET: a promising technique that allows visualization of amyloid plaques.
4. Electroencephalogram (EEG). In AD patients, alpha waves are reduced, theta waves are increased, and the average frequency is reduced. It helps in differential diagnosis and detection of prion disease or epileptic states.
5. Cerebrospinal fluid (CSF) analysis. The level of beta-amyloid (Aβ42) in the CSF decreases, and the amount of total Tau and phosphorylated Tau increases. Aβ42 has a sensitivity of 86%, specificity of 90%; Tau protein has a sensitivity of 81–80%, specificity of 90–92%, supporting the diagnosis of AD. These markers help to differentiate the disease from other types of dementia, but are not used as the sole diagnostic standard[13-14].

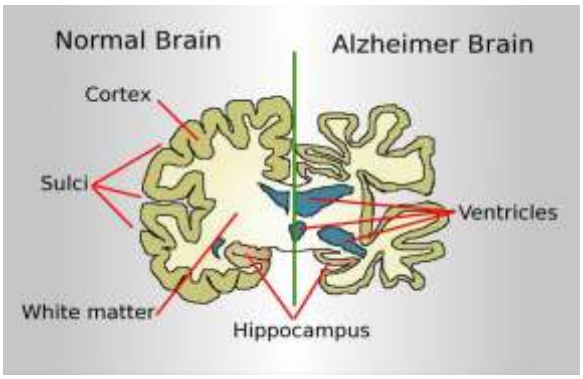

Figure 3. Healthy brain and Alzheimer's disease brain [15]

Treatment methods

1. Pharmacological treatment. Donepezil, Rivastigmine, and Galantamine are cholinesterase inhibitors that slow the breakdown of the neurotransmitter acetylcholine. These drugs are used to support memory and thinking functions.

Memantine is an NMDA receptor antagonist that reduces overstimulation of the neurotransmitter glutamate, which may be protective for neurons .

Newer therapies: for example, Lecanemab, a monoclonal antibody drug against beta-amyloid plaques.

Note: These medications do not completely cure the disease — they only slow its progression and help manage symptoms.

2. Non-pharmacological approaches and lifestyle changes. Cognitive and logical exercises - help support memory, attention, and thinking. Physical activity - walking, light sports, muscle activation - helps maintain smooth movements. Diet - antioxidant-rich foods (e.g., green vegetables, nuts, fish), diets aimed at maintaining cardiovascular health. Healthy sleep patterns, stress management, social activity, and communication - these factors also help slow the progression of the disease.
3. Rehabilitation and support. Psychological and social support for the patient and family members is important. Physiotherapy and movement exercises - to maintain movement and coordination. Creating a suitable environment at home to support the patient's independence - safe, well-lit, and allowing for trouble-free walking.

Risk group. Anyone can develop Alzheimer's disease, but certain groups are at higher risk for the disease.

1. Age-related group. The disease most often develops in people over 65 years of age. With age, the activity of neurons slows down and the risk of pathological accumulation of β amyloid and tau proteins increases.
2. Individuals with genetic factors. Those with the Apolipoprotein E (APOE) ε4 allele are more susceptible to the disease. The risk is increased if there is a family history of hereditary Alzheimer's disease.
3. Cardiovascular and metabolic diseases. People with diabetes, high blood pressure, high cholesterol, or chronic heart disease are at increased risk. These factors impair blood supply to the brain and lead to neuronal degeneration.
4. Lifestyle and environmental factors. Lack of physical activity, poor diet, smoking, and excessive alcohol consumption increase the risk. Prolonged stress and lack of sleep also negatively affect neuronal function.
5. with low social engagement . Individuals with limited social connections, living alone, or experiencing a lot of loneliness are at higher risk of cognitive decline.

Prevention.

1. Cognitive exercises and reading. Regular mental exercises (reading books, crossword puzzles, games, learning a new language) stimulate the activity of neurons. Cognitive exercises support brain plasticity and delay memory decline.

2. Physical activity. Walking, running, or light exercise 3–5 times a week improves cardiovascular and brain function. Physical exercise reduces stress and activates neurotrophic factors.
3. Healthy diet. The Mediterranean diet (green vegetables, fruits, nuts, fish, olive oil) is beneficial for brain health. It is recommended to reduce the consumption of sugar, trans fats and excess salt. Antioxidants and omega-3 fatty acids protect neurons.
4. Sleep and stress management. Quality sleep (7–9 hours) is important for memory and concentration. Stress reduction can be achieved through meditation, yoga, deep breathing, and social activities.
5. Control diseases and risk factors. Cardiovascular disease, diabetes, high blood pressure, and cholesterol levels affect brain health. Controlling them reduces the risk of disease. Limiting smoking and alcohol consumption also significantly reduces the risk.
6. Social activity. Staying connected with family and friends, and participating in clubs or groups supports mental health.

6. Conclusion

Alzheimer's disease, which is characterized by a gradual decline in brain function, has a significant impact on quality of life. It gradually reduces a person's memory, thinking, and ability to perform daily tasks. The risk of the disease is especially high in older people, those with a genetic predisposition, and those suffering from cardiovascular or other chronic diseases. Symptoms of the disease include memory impairment, slowed decision-making, changes in mood and behavior, difficulty performing daily tasks, and decreased movement and reflexes. Therefore, to prevent and slow its progression, it is important to adopt a healthy lifestyle - getting enough rest, eating right, managing stress, and engaging in physical and mental exercise. At the same time, early detection of the disease and appropriate treatment can significantly improve the patient's quality of life.

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