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A Comprehensive Review on Evaluation of Alzheimer Disease

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Abstract

Alzheimer disease (AD) is a progressive neurodegenerative disorder and the most common cause of dementia in elderly individuals worldwide. It is characterized by gradual decline in memory, cognition, behavior, and functional abilities, ultimately leading to complete dependence and death. The evaluation of Alzheimer disease involves a comprehensive clinical assessment, neuropsychological testing, laboratory investigations, and neuroimaging techniques to establish diagnosis, determine disease severity, and exclude other causes of dementia. Early and accurate evaluation is essential for timely intervention, symptomatic management, and improving quality of life. This review article provides a detailed overview of Alzheimer disease with emphasis on its pathophysiology, clinical features, diagnostic criteria, evaluation methods, biomarkers, complications, and current management strategies. The aim of this review is to provide a clear understanding of the evaluation process of Alzheimer disease for academic and clinical purposes.

Keywords: Alzheimer disease, Dementia, Cognitive impairment, Neurodegeneration, Evaluation, Biomarkers

1. Introduction

Alzheimer disease is a chronic, irreversible, and progressive disorder of the brain that primarily affects older adults. It accounts for approximately 60–70% of all dementia cases and represents a major public health challenge due to increasing life expectancy and aging populations. The disease was first described by Alois Alzheimer in 1906, who identified characteristic neuropathological changes in the brain of a patient with memory loss and cognitive decline.

Evaluation of Alzheimer disease is a complex process that requires integration of clinical history, cognitive assessment, laboratory findings, and imaging studies. Since no single test can definitively diagnose AD during life, a systematic and multidisciplinary evaluation approach is essential for accurate diagnosis and effective management.

2. Pathophysiology of Alzheimer Disease

The pathophysiology of Alzheimer disease is characterized by progressive neuronal degeneration and synaptic loss, particularly in the hippocampus and cerebral cortex. Two hallmark pathological features are extracellular accumulation of amyloid-beta ($A\beta$) plaques and intracellular formation of neurofibrillary tangles composed of hyperphosphorylated tau protein.

Amyloid-beta deposition disrupts neuronal communication and triggers inflammatory responses, while tau tangles impair microtubule stability and axonal transport. These pathological changes result in neuronal death, brain atrophy, and progressive cognitive impairment. Neurotransmitter deficits, especially acetylcholine deficiency, also play a significant role in the cognitive symptoms of AD.

3. Risk Factors and Etiology

Several risk factors contribute to the development of Alzheimer disease. Advanced age is the most significant risk factor. Genetic factors, including mutations in APP, PSEN1, and PSEN2 genes, are associated with early-onset AD, while the presence of the APOE $\epsilon 4$ allele increases the risk of late-onset AD.

Other risk factors include family history, cardiovascular diseases, hypertension, diabetes mellitus, obesity, smoking, low educational level, traumatic brain injury, and sedentary lifestyle. Environmental and lifestyle factors may influence disease onset and progression.

4. Clinical Features

The clinical presentation of Alzheimer disease typically begins with mild memory impairment, particularly affecting recent events and new information. As the disease progresses, patients develop difficulties in language, problem-solving, orientation, judgment, and visuospatial skills.

Behavioral and psychological symptoms such as depression, anxiety, agitation, hallucinations, and personality changes are common in later stages. Functional impairment gradually worsens, leading to inability to perform activities of daily living and complete dependence on caregivers.

5. Evaluation and Diagnostic Approaches

Evaluation of Alzheimer disease involves a detailed medical history, cognitive and functional assessment, physical and neurological examination, and supportive investigations. Information from caregivers is crucial for assessing symptom onset and progression.

5.1 Cognitive Assessment

Standardized cognitive tests such as the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog) are commonly used to assess cognitive function and disease severity.

5.2 Laboratory Investigations

Laboratory tests are performed to rule out reversible causes of dementia, including vitamin B12 deficiency, hypothyroidism, infections, and metabolic disorders. Routine blood tests include complete blood count,

electrolytes, liver function tests, and thyroid profile.

5.3 Neuroimaging

Neuroimaging plays a vital role in the evaluation of Alzheimer disease. Magnetic resonance imaging (MRI) reveals cerebral atrophy, particularly in the hippocampus and temporal lobes. Computed tomography (CT) scans help exclude structural lesions. Advanced imaging techniques such as PET scans can detect amyloid deposition and reduced glucose metabolism.

5.4 Biomarkers

Cerebrospinal fluid (CSF) biomarkers such as decreased amyloid-beta and increased tau protein levels support the diagnosis of Alzheimer disease. Blood-based biomarkers are emerging as promising tools for early detection and monitoring.

6. Complications of Alzheimer Disease

Alzheimer disease is associated with numerous complications, including increased risk of falls, infections, malnutrition, dehydration, and pressure ulcers. Neuropsychiatric complications contribute to caregiver burden and institutionalization.

Advanced stages of AD may lead to severe disability, aspiration pneumonia, and increased mortality. Early evaluation and appropriate management can help reduce complications and improve patient outcomes.

7. Management Strategies

Although there is no cure for Alzheimer disease, management focuses on symptomatic treatment and supportive care. Cholinesterase inhibitors such as donepezil, rivastigmine, and galantamine are used to improve cognitive symptoms. Memantine, an NMDA receptor antagonist, is used in moderate to severe stages.

Non-pharmacological interventions including cognitive stimulation, behavioral therapy, physical activity, and caregiver education are essential components of management. Control of comorbid conditions and lifestyle modifications may slow disease progression.

8. Prognostic Implications

The prognosis of Alzheimer disease varies among individuals but is generally poor due to its progressive nature. Early diagnosis through proper evaluation allows timely initiation of therapy, planning of care, and improved quality of life.

Disease progression leads to increasing cognitive and functional decline, emphasizing the importance of early and accurate evaluation strategies.

9. Future Directions and Research Opportunities

Ongoing research focuses on early diagnostic biomarkers, disease-modifying therapies, and preventive strategies. Advances in neuroimaging, genetics, and molecular biology hold promise for improved evaluation

and treatment of Alzheimer disease.

10.Conclusion

Evaluation of Alzheimer disease requires a comprehensive and multidisciplinary approach integrating clinical, cognitive, laboratory, and imaging assessments. Early and accurate diagnosis is crucial for effective management, reducing complications, and supporting patients and caregivers. Continued research is essential to enhance diagnostic accuracy and develop effective therapeutic interventions.

Declaration of Conflicting Interests

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