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A Comprehensive Review of Alzheimer's Disease: Understanding the Causes, Diagnosing the Condition, and Exploring Current Treatments

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ABSTRACT :

Alzheimer's Disease (AD) is a progressive brain disorder that causes memory loss, confusion, and changes in behavior and personality. It's the most common form of dementia, affecting millions worldwide—especially as more people live longer. This review explores what's happening inside the brain during Alzheimer's, how doctors detect the disease, and what treatments are currently available. We also take a look at some of the major research breakthroughs, focusing on things like amyloid plaques and tau tangles, and how these may be targeted with future therapies. While there's still no cure, ongoing research continues to bring hope for better diagnosis, care, and possibly even prevention down the line.

Keywords : Alzheimer's Disease, Dementia, Memory Loss, Brain Degeneration, Amyloid Beta, Tau Proteins, Diagnosis, Treatment, Clinical Trials, Personalized Medicine

Introduction

Alzheimer's Disease is one of the most heartbreaking brain disorders, becoming more common as our global population ages. Discovered by Dr. Alois Alzheimer in the early 1900s, the disease causes gradual cognitive decline, impacting memory, speech, and daily functioning. It doesn't just affect the person diagnosed—it deeply impacts families and caregivers, too. This paper breaks down what we currently know about Alzheimer's, from the biological changes it causes in the brain to the challenges of early diagnosis and the latest treatment options.

What's Going on in the Brain?

At the heart of Alzheimer's are two major culprits: amyloid plaques and tau tangles. Amyloid plaques are sticky clumps of protein that build up between brain cells, making it hard for them to talk to each other. Tau tangles, on the other hand, are twisted proteins that clog up the inside of brain cells, eventually killing them. Together, these cause brain cells to stop working properly, leading to memory loss and confusion.

Genetics also play a role—some gene mutations (like APP, PSEN1, and PSEN2) increase the risk of getting Alzheimer's. But it's not all about genes. Lifestyle, environment, and other unknown factors also come into play.

How Is Alzheimer's Diagnosed?

Diagnosing Alzheimer's isn't easy. There's no one test that gives a definitive answer. Instead, doctors use a mix of memory tests, medical history, and brain scans. Imaging like PET scans can show signs of amyloid plaques or tau tangles, but they're expensive and not always available. Researchers are

also looking into testing spinal fluid for markers like amyloid and tau proteins. Catching the disease early is still a big challenge—but it's critical for better treatment outcomes.

Treatment

Right now, there's no cure for Alzheimer's. Most treatments aim to manage symptoms or slow the disease down. Medications like donepezil help boost brain chemicals involved in memory. Another drug, memantine, helps balance different brain signals. More recently, scientists have been testing monoclonal antibodies—lab-made proteins that target amyloid plaques. One such drug, aducanumab, shows promise, though the results have been mixed so far. Research is ongoing to see how effective these treatments really are in the long run.

Clinical Trials

Alzheimer's research is full of hurdles. Creating animal models that mimic the disease isn't easy, and the slow progression of symptoms means clinical trials can take years to complete. Recruiting patients is also tough—cognitive decline can make participation difficult. And even when a treatment shows potential, making it widely available is a huge challenge. We'll take a look at some of the successes and setbacks in recent trials, and what needs to change to speed up progress.

The Future:

There's a lot of excitement about personalized medicine—customized treatments based on someone's genes, lifestyle, and environment. This approach could help identify people at higher risk and offer them early, targeted interventions. New ideas like stem cell therapy and gene editing are also being explored. While many of these innovations are still in the research phase, they hold promise for transforming how we treat—and maybe even prevent—Alzheimer's in the future.

Conclusion

Alzheimer's Disease continues to be a major health challenge, affecting millions around the world. While today's treatments mostly focus on symptoms, the future looks brighter. New research into how the brain works, better diagnostic tools, and more precise treatments like amyloid-targeting drugs are helping to push the boundaries. Personalized medicine, in particular, offers a hopeful new direction. But there's still a long road ahead. Continued research, awareness, and support are essential to make real progress in fighting this devastating disease.

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