# NIRF Spectroscopy and Nuclear Medicine for Early Alzheimer's Disease Diagnosis

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## Commentary

Early diagnosis of diseases such as Alzheimer's (AD) and cancer is critical for successful therapy. Cancer is the second leading cause of mortality after heart disease, and Alzheimer's disease is the third leading cause of death, with huge human and financial/economic effects worth trillions of dollars. Nuclear Medicine deals with the use of nuclear science and engineering techniques and expertise in medicine. Positron Emission Tomography (PET) and CAT/ CT, as well as Nuclear Magnetic Resonance Imaging (NMRI/MRI), are three primary Nuclear Medicine techniques that have been established for diagnostic and research purposes. However, these three modalities have significant limits in terms of cost, picture resolution, and, in the case of CAT/CT and PET, patient irradiation. Near-infrared chemical imaging microspectroscopy and some fluorescence spectroscopic techniques, on the other hand, are capable of detecting and imaging single cancer cells and/or single molecules. These novel techniques are very appealing means for early detection of diseases such as cancer and Alzheimer's, which promise to reduce the fatality rate of patients through adequate diagnosis and treatment of such diseases at an early stage, due to their powerful capabilities combined with low diagnostic costs. Currently, the National Institutes of Health (NIH) only provides insufficient financing for clinical and research parts of these unique investigative and clinical diagnostic procedures using FT-NIRS and fluorescence spectroscopy for early detection of Alzheimer's disease and cancer. Alzheimer's disease is a disease whose cause is unknown. Its development is linked to a number of environmental and genetic risk factors.

An allele of the APOE gene is the most powerful genetic risk factor. A history of head injury, severe depression, and high blood pressure are all risk factors. Amyloid plaques, neurofibrillary tangles, and the loss of neuronal connections in the brain are all linked to the illness process. To rule out other possible reasons, a probable diagnosis is based on the patient's medical history and cognitive testing with medical imaging and blood tests. Initial symptoms are frequently misinterpreted as signs of normal ageing. For a definitive diagnosis, brain tissue must be examined, but this can only be done after death. Good diet, physical activity, and social engagement are all known to help with ageing, and these factors may also help to reduce the incidence of cognitive decline and Alzheimer's disease; scientific trials to investigate these possibilities were ongoing in 2019. There have been no studies that demonstrate that certain drugs or supplements can reduce risk. There are no treatments that can stop or reverse the disease's course, while some can temporarily alleviate symptoms. Affected people become more reliant on others for help, which puts a strain on caregivers. Social, psychological, physical, and economic stresses might all be present.

Exercise programmes may be advantageous in terms of daily activities

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and can perhaps improve outcomes. Antipsychotics are commonly used to treat behavioural difficulties or psychosis caused by dementia, although they are not usually advised because they provide little benefit and raise the risk of premature mortality. Alzheimer's disease has three stages, each marked by a gradual pattern of cognitive and functional decline. Early or mild, middle or moderate, and late or severe are the three stages. The condition is known to affect the hippocampus, which is linked to memory and is the source of the first signs of memory loss. The degree of memory impairment increases as the disease advances.

#### Prevention

There is no scientific proof that any specific measure is useful in avoiding Alzheimer's disease. The findings of global research on strategies to prevent or delay the beginning of Alzheimer's disease have been mixed. Epidemiological studies have suggested links between various modifiable factors like food, cardiovascular risk, pharmaceutical drugs, and intellectual activity, among others, and the risk of acquiring Alzheimer's disease in a community. More study, including clinical trials, will be needed to see if these factors can help prevent Alzheimer's disease.

#### Medication

Cardiovascular risk factors such as hypercholesterolemia, hypertension, diabetes, and smoking have been linked to an increased risk of Alzheimer's disease start and progression. Medications for high blood pressure may help to reduce the risk. The use of statins, which lower cholesterol, may be beneficial in Alzheimer's and other dementias, but not in vascular dementia, according to a review. In 2007, it was assumed that long-term use of non-steroidal anti-inflammatory medicines (NSAIDs) was linked to a lower risk of Alzheimer's disease. Evidence also suggested that NSAIDs could help with amyloid plaque inflammation; however trials were halted due to substantial side effects. There has been no completion of a preventative trial. Although they do not appear to be effective as a treatment, they were regarded to be suitable as pre-symptomatic preventives as of 2011 [1-5].

Although previously used, hormone replacement medication during menopause may raise the risk of dementia. Four acetylcholinesterase inhibitors (tacrine, rivastigmine, galantamine, and donepezil) plus memantine, an NMDA receptor antagonist, are used to treat the cognitive impairments associated with Alzheimer's disease. The acetylcholinesterase inhibitors are for people with mild to moderate Alzheimer's disease, while memantine is for people with moderate to severe Alzheimer's. Their use provides only a minor benefit. These medications have not been found to slow the onset of Alzheimer's disease in those with mild cognitive impairment. Nausea and vomiting are the most prevalent side effects, both of which are associated to cholinergic excess. These adverse effects occur in 10–20% of users, are mild to moderate in severity, and can be handled by gradually lowering drug doses.

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