A Hybridization of MRS, BAEPs and ERPs for Identifying the People Who are at Risk of Having Alzheimer's Disease

Kaneez Fatima Shad
Life Sciences, University of Technology Sydney, Australia
*E-mail: kaneez.Fatimashad@uts.edu.au

ABSTRACT

Introduction: Every three seconds someone in the world develops dementia and according to the National Institute of deafness and other communication disorders (NIDCD), it has been alerted that over 700 million people will suffer from deafness, meaning that one person in every ten people will have this condition. Similarly, International statistics showed that almost 50 million people worldwide are suffering from dementia, which is expected to increase to 131.5 million people by 2050.

Our previous work on linking hearing loss with dementia1 such as AD dementia and monitoring auditory neural tracks to improve the diagnosis of AD2 shows that changes in the neuronal work begins from the brain stem to the cortex and functional changes in the neurons modifies the structure of the brain stem and the cortices. Earlier our lab was also involved in identifying therapeutic targets for AD using herbal extracts such as Glycowithanolides from Withania somnifera (Ashwagandha)3 and inflammatory molecules

i.e., NLRP3 inflammasome4. In the above-mentioned projects, we were targeting Amyloid-β and tau to decrease the risk of AD, but the recent Lancet report, on dementia prevention, intervention, and care, mentioned that most people with normal cognition with only Amyloidβ and tau biomarkers never develop AD5. We realize the huge gap in the diagnostic accuracy of AD dementia and the challenges in identifying the predictive biomarkers for this disease.

Objectives

- To examine the hypothesis that there will be observable chemical changes in the brain stem prior to its structural changes.
- To assess whether the functional changes occur prior to the structural changes.
- To determine noninvasive and less expensive tests for early diagnosis of AD.

Methodology: Magnetic resonance spectroscopy (MRS) was used for imaging the inferior colliculi (IC) to measure the ratio of neuronal (axonal) degeneration marker N-acetyl aspartate (NAA) and glial marker myo-Inositol (MI) with respect to creatine (CR). Mini-mental State Examination

(MMSE) was employed to assess the cognitive difference between normal and mild cognitive impaired (MCI) population. Magnetic resonance imaging (MRI) was utilized to observe atrophy of medial temporal lobe and Electroencephalogram (EEG) spectral power was applied to evaluate Brain stem auditory evoked potentials (BAEPs) and Event related potentials (ERPs). Auditory stimuli gated EEG exhibits Auditory brain stem response (ABR) during its first less than 10 ms, auditory medial latency response (AMLR) in the following less than 100 ms and up to 1000 ms was denoted as event related potentials (ERPs).

Results: MRS of IC shows an increase in MI and decrease in NAA ratio with respect to CR in subjects with MMSE > 24, no sign of atrophy in the medial temporal lobe was observed using MRI. Abnormal BAEPs were observed with a substantial reduction in the electrical peak amplitude and an increase in time between two peaks.

Conclusion: It is concluded that the functional anomalies are presented prior to the structural abnormalities and monitoring the activities of the auditory sensory neuron will enhance the accuracy in the diagnosis of the Alzheimer's disease.

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Keywords: Alzheimer's disease, Brain stem auditory potentials, Electroencephalogram, Event related potentials, Magnetic resonance imaging.

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