CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

38305

Project Title

Mitochondrial Dysfunction: A Biochemical Pathway for Early Detection of Alzheimer's Disease

Abstract

Objectives/Goals

Alzheimer's Disease (AD) is the leading cause of dementia and memory loss in adults. The disease presents itself through cognitive impairment. Dementia, memory loss, buildup of beta-amyloid plaques in the brain and tau proteins are associated with AD, which can only be confirmed by postmortem analysis. Early diagnosis has not been possible with AD, it is nigh impossible to treat. Unlike some forms of cancer and other diseases, there are no early diagnostic tests for AD. One of the characteristics of AD is dementia, which is caused by neuronal cell death. Cell viability is directly tied to mitochondrial function, thus, mitochondrial dysfunction is linked to cell death.Therefore we propose a novel diagnostic use of the MTT assay to facilitate early-stage detection of AD in at-risk populations.

Methods/Materials

To establish a link between mitochondria and Alzheimer's disease, we performed Ingenuity Pathway Analysis, and two networks were found that linked the genes coding for mitochondrial enzymes to genes for amyloid precursor protein. The MTT assay works through the conversion of MTT dye into formazan crystals by cells. The cells are then lysed, and the absorbance of the solution is an indicator of mitochondrial functionality and indirectly cell viability based on quantity of crystals produced. We performed the MTT assay to compare the viability of two sets of cell lines. We used Mouse Embryonic Fibroblast (MEF) cells and SH-SY5Y neuroblastomal cells. For both cell lines, one set of cells was transfected with a gene that expresses wildtype amyloid precursor protein (APP), and the other with a gene that expresses a form of APP that is significantly more likely to form beta amyloid plaques. We monitored both groups & conducted 4 trials, 3 on MEF and one on SH-SY5Y.

Results

Based on the graphs and tests for significance (2-sample paired t-test) our results support our hypothesis strongly for both MEF and SH-SY5Y cells. Differences were significant after 2 days of testing for MEF cells and 1 day of testing for SH-SY5Y cells.

Conclusions/Discussion

The data supports the hypothesis that mitochondrial dysfunction can be used as a biomarker of Alzheimer's disease, and that the use of the MTT assay is promising as a screening tool to detect Alzheimer's disease in its early stages. Further expansions of the project include testing of the assay with different cell lines, or using tau proteins in lieu of APP.

Summary Statement

This project established the MTT assay as an effective diagnostic of Alzheimer's disease based on mitochondrial functionality.

Help Received

The experiments were designed and performed entirely by ourselves. Mentoring and guidance about which cell types to use were provided by the PI of our lab, Dr. Luke Wiseman, of the Molecular Medicine department at the Scripps Research Institute.