CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S0513

Project Title

The Effects of Melatonin on Tau Hyperphosphorylation in Hypothermic SH-SY5Y Cells

Abstract

Objectives/Goals

This study was undertaken to prove that hypothermic conditions can be an in-vitro model of the tau hyperphosphorylation seen in Alzheimer's disease. Secondly, this study was an investigation of the viability of melatonin as a treatment for Alzheimer's disease, which can be applied to several other neurodegenerative disorders.

Methods/Materials

In this study, SH-SY5Y cells (purchased from ATCC) were grown in hypothermic temperatures (30 C) and compared against cells in prime growth conditions (37 C) to determine tau hyperphosphorylation at each temperature. Melatonin was tested on hypothermic-induced hyperphosphorylated tau producing SH-SY5Y cells in varying concentrations for a dose response and time course analysis. Melatonin was added to cells either with or without two hours of previous hyperphosphorylation-inducing incubation to test both preventative and reversal applications, totaling 36 combinations. Enzyme-linked immunosorbent assay (ELISA) was used to measure the expression of the pT181 isoform, a direct result of tau hyperphosphorylation.

Results

It was found that hypothermic conditions can induce tau hyperphosphorylation slightly at 12 hours and more drastically at 18 hours, up to 40%. However, by 24 hours of incubation the levels of tau hyperphosphorylation in the cells incubated at 30 C matched the levels of cells in the 37 C incubator. Therefore hypothermic incubation proves to be a model for Alzheimer's disease at 18 hours of incubation. Melatonin proved to reduce tau hyperphosphorylation at the 12 hours of incubation, and best at high concentrations. Preventative melatonin (when administered without previous hypothermic incubation) began to work at a lower concentration than reversal melatonin. At 18 and 24 hours of exposure, the melatonin did not have a significant effect. This shows that the effects of hypothermic incubation are stronger than the effects of melatonin, proving it to only be effective in high concentrations at early stages of hyperphosphorylation.

Conclusions/Discussion

Hypothermic incubation induces tau hyperphosphorylation best at 18 hours of incubation. This length and temperature of incubation can serve as an in-vitro model for Alzheimer#s disease among many other neurodegenerative diseases. Additionally, melatonin can reduce and prevent pathological behavior of tau only at high concentrations and early stages of hyperphosphorylation.

Summary Statement

I proved hypothermic incubation to be an in-vitro model for Alzheimer's disease and found melatonin to be an effective treatment in high concentrations for reducing the pathological behavoir of the tau protein.

Help Received

I did the literature review, experimental design, and lab work. Dr. Nikki Malhotra supervised initial development. Dr. Zin Htway supervised lab work at CSUCI, finalized protocol, and funded project. Cathy Hutchinson assisted with cell culture. Dr. Steve Wood helped choose materials and confirm methods.