Microscopic image analysis of the relationship between electrophysiological energy cost and dopaminergic neuronal degeneration in vitro.

https://neurodegenerationresearch.eu/survey/microscopic-image-analysis-of-the-relationship-between-electrophysiological-energy-cost-and-dopaminergicneuronal-degeneration-in-vitro/

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Microscopic image analysis of the relationship between electrophysiological energy cost and dopaminergic neuronal degeneration in vitro.

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2

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Research Abstract

Dopaminergic neurons in the substantia nigra pars compacta are selectively vulnerable to degeneration in Parkinson's disease. It is known that these neurons have a high demand for energy to support electrophysiological activity. The applicant seeks to test the hypothesis that dopaminergic neurons are selectively vulnerable to degeneration due to their high demand for energy to support electrophysiological activity. An individual dopaminergic neuron's demand for

energy can be quantitatively estimated for an individual neuron by morphological reconstruction and computational modelling of its electrophysiological activity using a recently published approach. The applicant shall establish a microscopic image analysis pipeline to quantify the morphological and electrophysiological characteristics of individual dopaminergic neurons using calcium and immunofluorescent imaging of microfluidic cell cultures. The applicant will provide input into the design of the microfluidic cell culture and image acquisition protocol, but the protocol will be implemented by a collaborator within the Systems Biochemistry Group. The applicant's image analysis pipeline will first be employed to regularly quantify the morphological and electrophysiological characteristics of microfluidic cell culture populations of PD associated mutant and isogenic control dopaminergic neurons, at individual cell resolution, over a prolonged period of time. In collaboration with Prof. Paul Bolam at the University of Oxford, this data shall then be used to generate a suite of computational models each of which quantitatively estimates the demand for energy within an individual dopaminergic neuron as a function of time. The applicant will then use survival analysis to test how this energetic demand relates to microscopically recorded degeneration events of individual neurons. This project uses automated image analysis to build a bridge between in vitro experimental work and computational modelling of neurodegenerative mechanisms, uniting two strong themes of research within the LCSB.

Further information available at:

https://www.fnr.lu/projects/microscopic-image-analysis-of-the-relationship-between-electrophysiological-energy-cost-and-dopaminergicneuronal-degeneration-in-vitro-2/

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