Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 3

MGH 241, Easel 141

2:30 PM to 4:00 PM

Influence of Cardiorespiratory Coupling on the Risk of Sudden Unexpected Death in a Mouse Model of Dravet Syndrome

Sandy Liang, Senior, Biology (Molecular, Cellular & Developmental)
Mentor: Franck Kalume, Neurological Surgery and Pharmacology, UW/ Seattle Children's

Sudden unexpected death in epilepsy (SUDEP) is the most common type of death in people with intractable epilepsies, including Dravet syndrome (DS). DS is a treatment-resistant infantile-onset epilepsy syndrome with comorbidities of cognitive impairment and premature death. DS is caused by a heterozygous loss-of-function mutation in SCN1A, the gene encoding the α subunit of the type I voltage-gated sodium channel $Na_v1.1$. Cardiovascular dysfunctions have been identified as the main causes of SUDEP. Recent studies have indicated that changes in cardiorespiratory coupling can indicate signs of disease and predict disease susceptibility, such as schizophrenia. We used the established mouse model of DS, which carries a global knock out of Scn1a, and conducted an examination of cardiac and respiratory functions. We recorded video recordings, electroencephalogram (EEG), electrocardiogram (ECC), whole body plethysmography, and LabChart Software 8.0 (AD Instruments) in freely moving DS and wild type (WT) control mice. We then identified and characterized the defects in cardiorespiratory coupling strength associated with SUDEP risk in the DS mice. We hypothesize that cardiorespiratory coupling of DS mice, compared to the WT mice, is disturbed and results in increased complexity between the heart rate and respiration. Findings from these studies may indicate that cardiorespiratory coupling parameters can be used as biomarkers of susceptibility to sudden death in intractable epilepsies and in other severe neurological disorders.

POSTER SESSION 3

MGH 241, Easel 159

2:30 PM to 4:00 PM

A Noninvasive Treatment for Multiple Sclerosis Using High Intensity Focused Ultrasound in a Mouse Model

Aleksey N (Alik) Myroniv, Senior, Psychology
Innovations in Pain Research Scholar
Mentor: Pierre Mourad, Neurological Surgery
Mentor: Tessa Olmstead, Neurological Surgery

Impacting approximately 400,000 people in the United States, multiple sclerosis (MS) is a chronic inflammatory disease of the central nervous system, and the leading cause of disability among young to middle aged people in the developed world. It causes demyelination of neural axons in brain tissue, with associated loss of central and peripheral function. The Mourad lab specializes in applications of focused ultrasound. We, among others, have shown that transcranial delivery of pulsed focused ultrasound (pFU) can non-destructively activate central neural circuits, while others have shown enhanced myelin remodeling of axons activated by laser light in an optogenetic mouse model. Here, we hypothesized that targeted, transcranial pFU activation of axons within MS lesions in a rodent model would decrease the animals' demyelination and increase their re-myelination. To this effect, we performed pilot studies. After a baseline MRI session, we simulated MS-like pathology by feeding the mice .2% Cuprizone chow over the course of 10 weeks. We subsequently used MRI imaging two weeks after the end of their Cuprizone course to document de-myelination. This was followed by five days of half-hour long therapeutic transcranial pFU sessions, with subdermal EEG monitoring on the first day to verify neural activation. After a final MRI session, we histologically analyzed the brains of the animals, comparing myelin-stained corpus callosum on the hemisphere of the brain to control tissue. Our pilot study suggests a statistically significant increase in re-myelination in a mouse-model of MS.