PHARMACEUTICAL SCIENCES
JAMES L. WINKLE COLLEGE OF PHARMACY

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2025

PROJECT TITLE: Modulation of 5-HT Neuron Populations by TBI

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Project Description

Proposed project focuses on understanding how mild traumatic brain injury (TBI) effects different populations of serotonin (5-HT) neurons within the brain. Traumatic brain injury (TBI), including closed-head injury (CHI), is a leading cause of disability in the United States. Chronic neuropsychiatric comorbidities are associated with TBI, including depression, anxiety, and social withdrawal, however our understanding of the mechanisms driving these sequalae remains extremely limited. Serotonin (5-HT) is a monoaminergic neurotransmitter linked to the etiology of various neuropsychiatric disorders including depression, anxiety and altered social function, however the effects of TBI on 5-HT neurotransmission are not well understood. Using a preclinical model for TBI, we have discovered significant alterations in 5-HT levels and signaling that originates from 5-HT neurons located with a brain region containing 5-HT neuron cell bodies, namely the raphe nucleus (RN). Bulk RNA sequencing analysis has revealed significant repression in the expression of transcripts responsible for the identity, maintenance and function of specific 5-HT neuron subpopulations within the RN following TBI. We hypothesize that TBI alters the transcriptional landscape of specific 5-HT neuron populations following injury, an effect that disrupts the normal function and neuronal signaling of these cell populations. Our objective is therefore to determine the cell specific transcriptional alterations occurring within defined 5-HT neuron subpopulations following TBI. To achieve this objective, single nuclei RNA sequencing studies will be conducted on raphe samples at time points following injury and transcriptional alterations in specific 5-HT neuron subpopulations elicited by injury will be determined. Work proposed will for the first time, delineate the actions of TBI in altering the identity and function of 5-HT neuron subpopulations within the brain, neurons that may have defined contributions to the behavioral and functional consequences of TBI.