

INTERNAL MEDICINE
COLLEGE OF MEDICINE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 02/25/2022

PROJECT TITLE: Non-invasively disrupting the blood-brain barrier to treat neurological diseases

Kevin Haworth, PhD
College of Medicine
Cardiovascular Center, 3939
Cincinnati, OH 45267-0586
hawortkn@ucmail.uc.edu
Phone: 513.558.3536

Mona Mirheydari, PhD
College of Medicine
Cardiovascular Center, 3950
Cincinnati, OH 45267-0586
mirheyma@ucmail.uc.edu

Project Description

The brain is a complex and sensitive organ. To ensure its proper function in healthy individuals, a border of endothelial cells selectively prevents solutes in the blood from entering the extracellular fluid of the central nervous system where neurons reside. This is known as the blood brain barrier (BBB). The BBB is critical for preventing harmful substances such as toxins and antigens from diffusing into brain tissue. However, it also limits the delivery of therapeutic drugs. Thus overcoming the BBB is considered as one of the keys to finding successful neurological therapies. Focused ultrasound (FUS) combined with microbubbles has emerged as an effective method to perform targeted drug delivery to the brain through the blood-brain barrier (BBB). Exposure of microbubbles (smaller than a red blood cell) to focused ultrasound results in energy release (through cavitation), which leads to safe and temporary BBB disruption. Through this method, passage of drug molecules to specific areas of the brain is possible. Injecting microbubbles prior to focused ultrasound exposure, reduces the amount of energy needed for BBB disruption, which also reduces the risks of tissue damage. This method can be used in treating a wide range of neurologic conditions such as Alzheimer's Disease and glioblastoma tumors. In the Haworth lab, we have performed successful pre-clinical BBB, and optimized the ultrasound parameters. Our lab runs interdisciplinary research and participating in this project will provide students the opportunity to broaden their knowledge in MATLAB programming, image analysis, physics, ultrasound, cerebrovascular biology, biology, and engineering. Students will also have the chance to participate in projects in collaboration with other laboratories and departments.