

FIGHT MND.

Project

Drug delivery/Gene therapies

Enhancing delivery of gene therapy to motor neurons and glial cells using focused ultrasound

A major obstacle for treating MND is the blood-brain barrier, a protective lining between the blood and brain that prevents entry of most drugs into the brain. This project aims to enhance the delivery of a genetic drug for MND to the brain using focused ultrasound, a safe new technique that temporarily opens the blood-brain barrier. Investigators will assess if focused ultrasound allows the genetic drug to pass from the body into the brain of a preclinical MND model more readily, to increase its ability to reach and act on motor neurons.



Project Lead

Dr Kara Vine

University of Wollongong, NSW

Dr Kara Vine says it was the diagnosis of MND in a close friend and work colleague in 2016 that led her to think about ways we could improve the delivery drugs to the central nervous system, and treat those living with MND. Her background in drug delivery meant she was well placed to tackle this challenge.

Site-specific drug delivery

Currently, Dr Vine's team is focused on improving site-specific drug delivery for cancer and MND.

"We use targeted nanoparticles and polymeric scaffolds to enhance drug solubility, enable targeted delivery, and provide improved therapeutic efficacy with reduced toxicity profiles," she says.

Dr Vine explains that *"a major obstacle facing the effective treatment of diseases such as MND is the blood-brain barrier (BBB) and blood-spinal cord barrier (BSCB)."*

"The BBB is a physical barrier between the brain's blood vessels and the cells and other components that make up brain tissue."

"Together, the BBB and BSCB prevent the passage of certain drugs from the circulatory system into the central nervous system where they are required. Therefore, it is nearly impossible for therapeutic drugs to target the diseased cells without the assistance of drug 'carriers' and/or physical disruption to overcome such barriers," she explains.

Dr Vine and her team have designed a drug carrier (nanoparticle) that can increase the delivery of drugs into the brain and are now working to enhance the penetration and targeting capabilities of this drug carrier by using externally applied, non-invasive focused ultrasound.

"Focused ultrasound is a safe and relatively new technique that selectively disrupts the BBB/BSCB, thereby increasing its permeability to drugs into regions of interest within the central nervous system," she explains.

Excitement and gratitude

Dr Vine says she was *"absolutely thrilled"* to learn that she had been awarded an IMPACT grant from FightMND.

"My immediate reaction was that of excitement and gratitude. The outcomes of this project will have major impact on the types of drugs that can be delivered to motor neurons, opening up many new potential avenues of therapy for both sporadic and familial forms of the disease. I am extremely grateful to FightMND and their fundraising community for supporting this work," she says.

FightMND has invested \$249,939 in this research.

About Dr Kara Vine

Dr Kara Vine is a Senior Research Fellow in the School of Chemistry and Molecular Bioscience at the University of Wollongong. Her lab is based in the Illawarra Health and Medical Research Institute, Wollongong.

Dr Vine has over a decade of experience in the design and preclinical assessment of targeted anti-cancer and MND therapeutics. Her program of research is centred on developing novel nanomedicines and polymeric scaffolds for site

specific drugs. She is the lead inventor on four drug delivery patents and has made significant contributions to an all-in-one chemotherapy formulation that has completed a Phase 1b/2a clinical trial in Wollongong. Dr Vine has trained internationally at the Finsen Laboratory, Copenhagen, Denmark and University of Malmo, Sweden.