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(U*) Measuring Axon Diameters within the Mouse Corpus Callosum using Oscillating Gradient Spin Echo MRI Sequences

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The brain is made of billions of cells called neurons, which are responsible for conducting electrical signals between the central nervous system and the rest of the body. The axon is the thread-like projection of the neuronal cell body and is usually insulated by the myelin sheath. The two hemispheres of the brain are connected by a white matter tract called the corpus callosum and the degeneration and dysfunction of axons within this brain region is indicative of many disorders, including Multiple Sclerosis. Such degeneration can be seen in the decreasing diameters of axons within the corpus callosum.
Current methods for measuring axon diameters require *ex vivo* tissue samples and electron microscopy analysis. Recently, Magnetic Resonance Imaging (MRI) is proving to be a useful tool for measuring axon diameters. Oscillating Gradient Spin Echo (OGSE) MRI pulse sequences can be used to probe micron-sized structures within the sample. This project investigated the use of OGSE sequences to measure axon diameters in the mouse corpus callosum. A CDI (Clostridioides difficile Infection) male mouse was anesthetized using isoflurane and perfused according to University of Winnipeg and Manitoba CACC protocol. Following sacrifice, the mouse brain in skull was isolated then soaked in paraformaldehyde for 48 hours, followed by phosphate-buffered saline for another 48 hours prior to imaging. The mouse brain was then transferred to a holding tube filled with Fomblin and the tube was placed inside the 21 cm horizontal bore 7 Tesla Bruker Magnet. Images were registered, ROIs were drawn in the corpus callosum, and axon diameters within the corpus callosum were inferred using custom-built Matlab code.
Axon diameters in various regions of the corpus collosum were inferred to be 5.4±0.8μm, 5.3±0.7μm and 6±1 μm. MRI using OGSE pulse sequences can probe micron-sized axons in fixed biological tissues. The next step is to reduce the uncertainty in the measurements.
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Keyword-1

magnetic resonance imaging

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brain

Keyword-3

rodent model

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