RESEARCH SCHOLAR PROGRAM 2017
SUPERVISOR/PROJECT INFORMATION FORM

Due on or before October 21 2016. Forms received after this date will not be posted on the website.

SUPERVISOR INFORMATION

Supervisor Name: Michael Fehlings

Mailing Address: 399 Bathurst Street, Suite 4W-449, Toronto, ON, M5T 2S8

Telephone Number: 416 603 5627

Email Address: michael.fehlings@uhn.ca

Degree (MD, PhD, MD/PhD): MD PhD

Academic Rank: Professor

Field of Research: Spinal Cord Injury

Graduate School Appointment (IMS, IHPME etc..): IMS
Please note that you must be appointed to the SGS in order to be a supervisor in the Scholar Program

Research Institute Affiliation (if applicable): Krembil Research Institute at Toronto Western Hospital

Allocation of student contact time (# of hours per week you are available to the student for any concerns or to review progress): 2-3 hrs/week

Do you have a student that you have already agreed to work with? NO
Please note, you may go ahead with a self-initiated project with a student of your choosing. If you choose this option, your project will not be posted online, meaning it will not be open to student applicants.

PROJECT INFORMATION

Project Title: A prospective longitudinal study using quantitative multi-parametric spinal cord MRI to measure microstructure and tissue injury in patients with degenerative cervical myelopathy.

Project Description (max 500 words):

Quantitative MRI (qMRI) techniques have the potential to provide in vivo measurement of specific tissue properties, including characterizing aspects of spinal cord (SC) microstructure and tissue injury. However, efforts to apply qMRI in clinical studies have thus far achieved only modest success. The strongest results include cross-sectional area (CSA) as a measure of spinal cord atrophy, the diffusion tensor imaging (DTI) metric fractional anisotropy (FA) to evaluate axonal integrity, and magnetization transfer ratio (MTR) as a measure of demyelination. Spinal cord CSA has shown moderate to strong correlation with disability in multiple sclerosis (MS), but is a non-specific measure of tissue injury and may be difficult to detect, given considerable inter-subject variability in SC CSA in healthy subjects. FA has demonstrated moderate correlation with global and focal disability in several spinal cord pathologies, but has yet to achieve clinical uptake due to cumbersome analysis techniques and a lack of standardized acquisition methods. MTR has also shown correlation with impairment in MS and spinal cord injury (SCI) studies, but results have been inconsistent, notably due to T1 and frequency offset dependencies, and thus insufficient to drive clinical adoption. High resolution T2*-weighted (T2*w) imaging is available on all major MRI vendors. At 3T or higher field strength, T2*w images provide strong contrast between grey matter (GM) and white matter (WM), allowing segmentation between these compartments and calculation of their CSA. It has also been established that T2*w shows hyperintensity in injured WM in various pathologic conditions. We hypothesized that T2*w hyperintensity is a general phenomenon in WM injury leading to decreased grey-white contrast, and can be quantified by normalizing the WM signal intensity within each axial slice by that of the GM, as T2*w WM/GM signal intensity ratio.

We propose a simplified approach to cervical SC qMRI with clinically feasible methods, including acceptable acquisition time, standard hardware/pulse sequences, and automated image analysis. Our protocol yields 4 measures of SC tissue injury (CSA, FA, MT ratio (MTR), and T2*w WM/GM). Investigation in 32 healthy subjects established that T2*w WM/GM has lower inter-subject and test-retest variability compared with FA and MTR, although the latter 2 metrics also showed acceptable results. These encouraging findings prompted the current study in degenerative cervical myelopathy (DCM), a common condition involving degeneration of the discs, ligaments, and vertebrae resulting in cervical spinal cord compression and functional impairment. We aim to determine if our quantitative measures (i) differ between patients with DCM and healthy subjects, (ii) correlate with global disability and focal neurological deficits when extracted from corresponding regions of WM, (iii) can be used to develop an effective diagnostic tool, (iv) can detect subclinical tissue injury in asymptomatic subjects that have mild cord compression, (v) can detect subtle worsening of spinal cord tissue injury in patients managed non-operatively (at 1 year follow-up), and (vi) can predict clinical outcomes (with or without surgical decompression) at 1 year.

If human subjects are involved, has Ethics been obtained?

☒YES ☐NO ☐Application Submitted ☐N/A

Do you expect this work will be published within 20 months?

☒YES ☐NO ☐Uncertain

Student's Roles / Responsibilities (Please be as specific as possible) Please indicate who will serve as the student's direct report. (PI, PDF, PhD student, technician etc…):

The student will work closely with a current PhD student Dr. Allan Martin, a PGY4 Neurosurgery Resident who is leading this study. The student will also interact with Post-Doctoral Fellow Nobuaki Tadokoro, who is a Japanese Orthopedic Spine Surgeon who is completing a clinical research fellowship project in this area, and Dr. Ali Akbar (PGY3 Neurosurgery Resident) who will begin his PhD studies in this area in July 2017. The student will be required to read material to gain a basic understanding of quantitative MRI techniques and clinical research, including the array of clinical measures that we employ in our studies. He/she will assist the team in data acquisition, analysis, and writing of research reports. There will also be opportunities to be involved in side projects including 2 multi-center MRI studies that we are strongly involved in, as well as other projects such as literature searches and writing of review papers.