MRI PROTOCOL HARMONIZATION FOR NEURODEGENERATION, VASCULAR DISEASES AND BRAIN INJURY: REGIONAL, PROVINCIAL AND NATIONAL COHORTS

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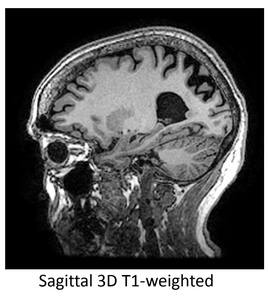
RATIONALE

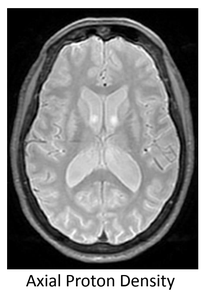
- Large-scale neuroimaging projects are constantly evolving
- Extensive collaboration by diverse groups is necessary to maximize efficiency with increasingly competitive funding sources
- Great need for harmonization of imaging protocols across projects, vendor platforms (GE, Philips, Siemens) and recruitment sites
- This harmonization aims to optimize the compatibility of the imaging acquired at each scanner-site
- Allows data from many sources to be pooled and shared
- Allows for many projects to leverage the resources of others, both financially and in terms of the sometimes limited number of patients with a given condition that are available for recruitment

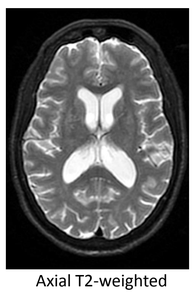
METHOD

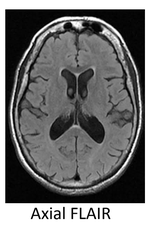
- One such initiative is the Canadian Dementia Imaging Protocol (CDIP)
- Championed by a group of physicists, physicians and research coordinators from across Canada
- Represents diverse projects including:
  - Canadian Consortium for Neurodegeneration and Aging (CCNA)
  - Canadian Alliance for Healthy Hearts and Minds (CAHHM)
  - Consortium d'Identification de la Maladie d'Alzheimer – Québec (CIMAQ)
  - Ontario Brain Institute's Ontario Neurodegenerative Disease Research Initiative.
  - O2 study from the Consortium Québécois de Découverte du Médicament
  - Medical Imaging Trials Network of Canada (MITNEC) – C6
  - Toronto Dementia Research Alliance

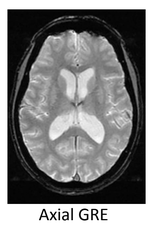
PROTOCOL

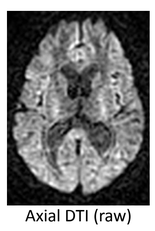

Sagittal 3D T1-weighted

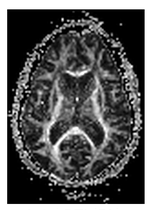

Axial Proton Density

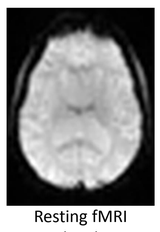

Axial T2-weighted

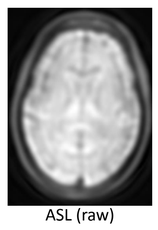

Axial FLAIR

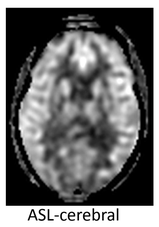

Axial GRE


Axial DTI (raw)


Axial DTI (FA)


Resting fMRI (raw)


ASL (raw)


ASL-cerebral blood flow

- The protocol includes sequences applicable across many disease states such as dementia, neurodegeneration, traumatic brain injury (TBI), amyotrophic lateral sclerosis (ALS), Parkinson 's disease, and multiple sclerosis
- The protocol includes:
  - high-resolution 3D isotropic T1-weighted (for anatomical detail)
  - interleaved proton-density/T2 weighted image (for reliable skull-stripping and lesion detection of deep grey and white matter)
  - a fluid-attenuated inversion recovery (FLAIR) image (for quantification of white matter hyperintensities)
  - T2-star gradient echo (for detection of microbleeds)
  - diffusion tensor image (DTI - microstructural integrity and connectivity)
  - resting state blood oxygen level dependent (BOLD) functional MRI (to discern functional connectivity)
- Arterial spin labeling (ASL) to measure regional cerebral blood flow is also being considered.

IMPLICATIONS

- Other large-scale studies of AD such as the Alzheimer's Disease Neuroimaging Initiative (ADNI) have led the way to develop harmonized cross-platform protocols
- However, the sequences acquired for ADNI are more limited and don't include modern hardware and software improvements
- The ADNI population captures purer forms of Alzheimer's Disease with lower representation of SVD than encountered in a real world population
- This relates to their focus on clinical trials but diminishes the generalizability of the findings

FUTURE DIRECTIONS

- Although still in its early stages, this harmonization could result in imaging well over 15,000 Canadian participants from a wide variety of populations and will allow for an unprecedented understanding of the brain through the stages of normal aging and disease.

ACKNOWLEDGEMENTS

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