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

• 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.

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