Development of a Semiautomated Volumetric Quantification Method for Cerebral Microbleed Burden using T2* Weighted Imaging

Ahmed Bahrani, MS [1] • Omar Al-Janabi, MS [2] • Danny Rose, MD [3] • Guoqiang Yu, PhD [4] • Donna Wilcock, PhD [5] • Charles Smith, MD [6] • Gregory Jicha, MD, PhD [7]

[1]Department of Biomedical Engineering and Sanders-Brown Center on Aging , University of Kentucky • [2]Departments of Behavioral Science and Sanders-Brown Center on Aging, University of Kentucky • [3]Department of Neurology, University of Kentucky • [4]Department of Biomedical Engineering, University of Kentucky • [5]Department of Physiology and Sanders-Brown Center on Aging, University of Kentucky • [6]Department of Neurology, Sanders-Brown Center on Aging, and Magnetic Resonance Imaging and Spectroscopy Center (MRISC) , University of Kentucky • [7]Departments of Behavioral Science, Neurology, and Sanders-Brown Center on Aging, University of Kentucky

Abstracts will be considered for both poster and platform presentations

Stroke/Neurovascular

Background:
Cerebral microbleeds (CMB) can be visualized on T2*, susceptibility weighted (SWI), and gradient echo (GRE) MRI images. CMB result from rupture of cerebral microvessels that can be associated with cerebral amyloid angiopathy, diffuse axonal injury, hypertension, and small vessel ischemic disease. While semiquantitative visual rating scales have been developed to examine the extent of CMB, published protocols allowing quantification of CMB volumes are lacking in the literature.
Method:
T2*-weighted images., SWI, MPRAGE and FLAIR MRI images were derived from nine elderly subjects, seen at the Sanders-Brown Center on Aging selected on the basis of visual rating scale scores for CMB. The developed protocol includes coregistering T1 and T2-weighted images, followed by segmentation to create four different tissue masks, gray-matter (GM), white matter (WM), CSF and misclassified tissue. SWI images are then registered to the subject's native space and a manual editing step is performed to remove non-brain and CSF tissue artifacts. Mean and standard deviation from the original tissue masks are then used to threshold the SWI mask using 1xSD to 4xSD, allowing. CMB total volume to be calculated.
Results:
CMB and white matter hyperintensity (WMH) volumes for the aggregate study subjects were, 8941 ± 12266 and 20 ± 589 mm3 respectively). CMB volume was shown to increase with increasing WMH volume. Individual scans can be processed in 20-30 minutes with high accuracy and reliability using this protocol.
Conclusions/future work:
The developed protocol represents a significant advance in the volumetric quantification of CMB that can be readily applied to the study of a variety of neurologic conditions associated with CMB appearance and progression including stroke, small vessel ischemic disease, hypertensive brain injury, traumatic brain injury, and Alzheimer's disease. Future work will focus on validating the protocol in relation to these neurologic conditions in a larger number of subjects, further refining the methodology to include measures of anatomic distribution and developing strategies to generate comparable data acquired through other MRI imaging sequences such as T2* and GRE.