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IMAGING IN NORMAL BRAIN AGING

Choice of Inversion Time for Arterial Spin Labeling MRI in the U.S. POINTER Lifestyle Intervention Trial

Youngkyoo Jung[1] | Sarah Y. Hong[1] | Donghoon Kim[1] | Prashanthi Vemuri[2] | Bret J. Borowski[2] | Clifford R. Jack Jr.[2] | Robert A. Koeppe[3] | Samuel N. Lockhart[4] | Theresa M. Harrison[5] | Leslie Gordineer[4] | Nancy Woolard[4] | Mark A. Espeland[4] | Danielle J. Harvey[1] | Laura Lovato[4] | Arthur W. Toga[6] | Joseph C. Masdeu[7] | Hwamee Oh[8] | Darren R. Gitelman[9] | Neelum T. Aggarwal[10] | Maria C. Carrillo[11] | Heather M. Snyder[11] | Rachel A. Whitmer[5] | Laura D. Baker[12] | Charles S. DeCarli[13] | Susan M. Landau[5]

[1]University of California, Davis, CA, USA

[2]Mayo Clinic, Rochester, MN, USA

[3]University of Michigan, Ann Arbor, MI, USA

[4]Wake Forest School of Medicine, Winston-Salem, NC, USA

[5]University of California, Berkeley, CA, USA

[6]Stevens Neuroimaging and Informatics Institute, University of Southern California, Los Angeles, CA, USA

[7]Houston Methodist Research Institute, Houston, TX, USA

[8]Alpert Medical School of Brown University, Providence, RI, USA

[9]Advocate Aurora Health, Chicago, IL, USA

[10]Rush Alzheimer's Disease Center, Department of Neurological Sciences, Chicago, IL, USA

[11]Alzheimer's Association, Chicago, IL, USA

[12]Wake Forest University School of Medicine, Winston-Salem, NC, USA

[13]University of California Davis, Davis, CA, USA

Correspondence
Youngkyoo Jung, University of California, Davis, CA, USA.
Email: yojung@ucdavis.edu

Abstract

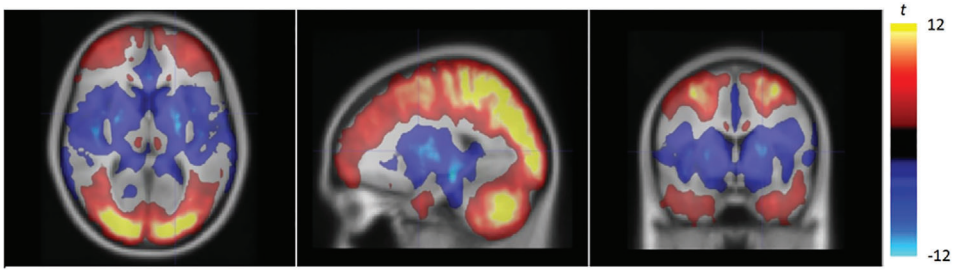
Background: The U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (U.S. POINTER) is a 2-year randomized controlled trial to evaluate the effect of lifestyle interventions in older adults (60-79 years). The POINTER Imaging ancillary study is collecting Arterial Spin Labeling (ASL) MRI data to map cerebral blood flow (CBF) and evaluate the effect of interventions in the perfusion imaging biomarker. The optimization of timing parameters is essential for robust and efficient acquisition of ASL MRI.

Method: A subset (n=83; F/M=51/32; age=69.0±5.5) of POINTER Imaging participants at two imaging sites underwent two ASL MRI scans during the same baseline session. Two 3D Pulsed ASL were obtained with TI1 of 790ms and TI2 values of 2000ms or 2750ms, which provide the delay times (between labeling and imaging) of 1210ms or 1960ms. ASL images were quantified into a physiological unit of CBF, ml/100g/min, using a single compartment kinetic model. CBF maps from two scans were normalized into a standard space and a voxel-wise paired t-test was performed after site variations were harmonized and covariates (age and sex) were adjusted. The age and sex effects in the difference of CBF values between two scans were also examined using linear regression. To control false positives, clusters smaller than 41ml were removed based on a simulation with α=0.05.

Result: The CBF values in ASL MRI rely on the timing of image acquisition: only a fraction of label bolus arrives in the tissue with a short delay while images suffer from low signal due to the magnetization decay with a long delay. Figure 1 shows the regions that require a long delay time (red) or a short delay (blue). The difference in CBF is proportional to arterial transit time (ATT) and the analysis shows females have shorter

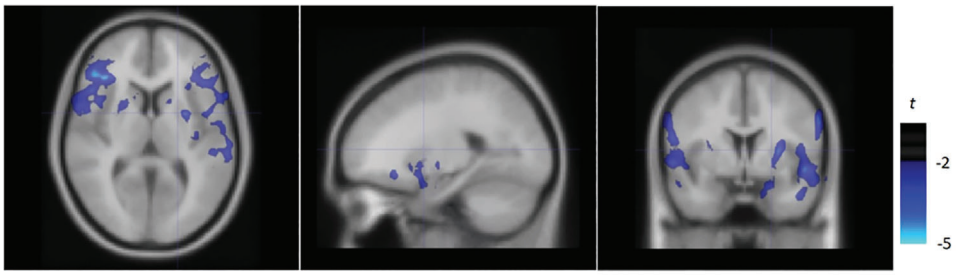
ATT mainly in the peri-Sylvian region (Figure 2). No cluster survived correction in the analysis of the aging effect.

Conclusion: The acquisition of two CBF maps not only offers optimization of acquisition timing but provides an additional perfusion parameter, arterial transit time, which may be a potential biomarker of cerebrovascular pathophysiology.



$CBF_{TI2=2750} > CBF_{TI2=2000}$

Figure 1. *t*-score maps representing significant differences between CBF values from two ASLs (one with TI2 of 2750ms, the other with TI2 of 2000ms). Positive t-score indicates arterial transit time (ATT) is likely longer than 1230ms while negative scores mean ATT is shorter than 1230ms. Most cortical regions show longer transit times while deep gray matter regions have shorter transit times.



$ATT_{female} > ATT_{male}$

Figure 2. *t*-score maps representing significant sex differences in delta CBF ($CBF_{TI2=2750}$ - $CBF_{TI2=2000}$) which is proportional to arterial transit time (ATT). Negative *t*-score indicates that females likely have shorter ATT mainly in the peri-Sylvian regions.