Title: Validation of ASL for Detection of Perfusion Abnormalities in Dementia: Comparison with the Gold Standard

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Structured Abstract:

Introduction. While ASL is a simple, non-invasive approach for measuring CBF, its poor signal-to-noise ratio and sensitivity to arterial transit times can limit its ability to detect perfusion abnormalities. This is particularly evident in studies involving frontotemporal dementia (FTD) patients, where reports on the diagnostic value of ASL have been inconsistent. Recent advances in ASL protocols, including optimized labeling parameters should enable detection of more subtle perfusion abnormalities. To evaluate this, this study presents a comparison of regional hypoperfusion maps generated using ASL and PET with radiolabeled water (15O-water), the invasive gold standard for measuring CBF in humans. Data were acquired using a hybrid PET/MR scanner to avoid variability in perfusion between imaging sessions and to minimize registration errors.

Methods. Data were acquired from 6 controls (age: 67.4 ± 8.7, sex: 3 female / 3 male) and 7 FTD patients (age: 65.6 ± 8.5, sex: 4 female / 3 male) on the Siemens biograph mMR. The patient population included a heterogenous sample of FTD subtypes. Five minutes of list mode data were acquired after a bolus injection of approximately 800Mbq of 15O-water. Data were reconstructed using an MR-based attenuation correction map and smoothed by a 4mm gaussian filter. Perfusion was quantified using a double-integration method. ASL data was collected immediately following the PET acquisition. ASL data were motion corrected and smoothed by a 4mm gaussian filter. ASL-CBF was calculated using a one compartment model. All perfusion data were normalized to the MNI template. Statistical maps showing regions of hypoperfusion were determined using a case-control design.

Results. Global CBF measured by ASL was: 64.0 ± 10.9 and 54.3 ± 12.2 ml/100g/min (ns) and by 15O-water was: 51.8 ± 10.3 and 45.8 ± 10.1 ml/100g/min (ns) in controls and patients respectively. ASL and 15O-water statistical parametric maps showed hypoperfusion in regions commonly associated with each FTD subtype.

Discussion. This work highlights the potential of ASL for identifying regional hypoperfusion in participants with FTD; preliminary data shows that ASL is capable of detecting subtle perfusion abnormalities. While 15O-water PET data showed greater sensitivity, as identified by larger and focal clusters on the t-maps, similar areas of hypoperfusion were identified by ASL. These results are in agreement with previous PET studies which showed decreased metabolism in these regions in similar patient groups. Future work will be to account for sources of variability such as partial voluming errors.