Comparison of 3T Arterial Spin Labelling and Dynamic Contrast Enhanced MRI in Multiple sclerosis

Afaf S Elsarraj[1], Paul S Morgan[2], Cris S Constantinescu[3], Dorothee P Auer[1], and Robert A Dineen[1]

[1]Sir Peter Mansfield Imaging Centre, School of Medicine, University of Nottingham, Nottingham, United Kingdom, [2]Medical Physics, Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom, [3]Clinical Neurology Group, Division of Clinical Neuroscience, University of Nottingham, Nottingham, United Kingdom

Target audience: Neuroradiologists and Clinical Neuroscientists

Purpose: Haemodynamic changes have been reported in multiple sclerosis (MS), using MRI perfusion techniques including ASL and DSC [1] [2] [3]. However, the extent to which the perfusion alterations detected are comparable between these techniques is not well understood. The aim of this study is to determine whether individual and group differences in perfusion measurements from basal ganglia (BG) of a cohort of MS patients and matched healthy controls made using arterial spin labelling (ASL) and dynamic contrast enhance-MRI (DCE-MRI) are comparable.

Methods This study was approved by a UK National Health Service Research Ethics Committee. Twenty six MS patients (6 Secondary progressive-MS, 18 Relapsing remitting MS, 2 Clinically isolated syndrome) and 22 age- and gender- matched healthy controls underwent 3T MRI (Discovery MR750, GE Healthcare), including FSPGR 3D (TE/TR 3.1/8.1 ms, TI 900 ms, Flip angle 8, matrix size 256 x 256, voxel size 1x1x1) , 3D ASL [4] (TE/TR=10.5/4632ms, slice thickness 4mm, resolution 1.875x1.875mm, echo train length 1) and DCE-MRI (Slice thickness 3mm, TE/TR 1.1/ 4ms, echo train length 1, flip angle 19, matrix size 256x256, resolution 0.875x0.875). Double-bolus injection technique was used for DCE-MRI [5]. Grey matter segmentation BG mask was created in standard space, using FSL 5.0. Cerebral blood flow (CBF) maps were generated from DCE-MRI using (JIM 5.0 software (Xinapse system)) with analysis limited to the first bolus. The arterial input function was identified manually at the left middle cerebral artery. The CBF maps from ASL were created using proprietary GE software [6]. Both CBF maps from ASL and DCE-MRI were registered in standard space using FLIRT linear registration via FSL software (FMRIB Software Library v 5.0, Analysis group, Oxford, UK). FSL maths was used to mask the basal ganglia to the CBF maps. Statistical analysis was performed using paired t-test for the within group comparison of BG CBF using ASL and DCE-MRI, independent-samples t test between group comparison of perfusion measures, and Pearson correlation for the correlation analysis between ASL and DCE-MRI perfusion measures.

Results: Comparison of BG CBF from ASL and DCE-MRI for all 48 participants showed (ASL-CBF 49.6±7.3, DCE-MRI CBF 50.71± 17.3 ml/100g/min, p=0.7). For MS participants, the DCE-MRI gave significantly lower CBF than ASL (DCE-MRI 42.9±11.5, ASL-CBF 49.7±8 ml/100g/min, p=0.03), whereas for control participants the DCE-MRI gave significantly higher CBF than ASL (DCE-MRI 59.8±18.6, ASL-CBF 49.4± 6.6 ml/100g/min, p=0.029). There was no correlation between BG CBF measures from ASL and DCE-MRI for all participants or for the MS and control cohorts separately. Group comparison between MS patients and control showed significantly lower CBF in the BG when measured by DCE-MRI (CBF-MS 42.9±11.5, CBF-controls 59.8± 18.6ml/100g/min, p=0.001), but no significant group difference in BG CBF when measured by ASL.

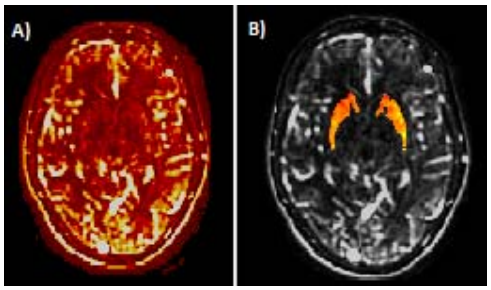

Figure 1. A) CBF map generated from (DCE-MRI) using (JIM 5.0 software)

B) Basal ganglia perfusion mask overlaid a CBF map (DCE-MRI)

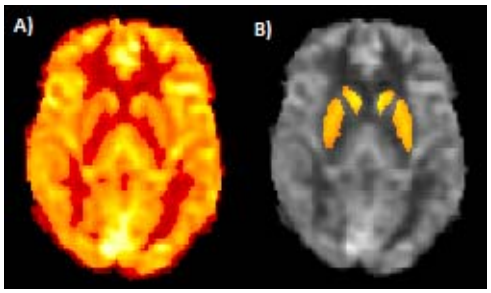

Figure 3. A) CBF map generated from (ASL)

B) Basal ganglia perfusion mask overlaid a CBF map (ASL)

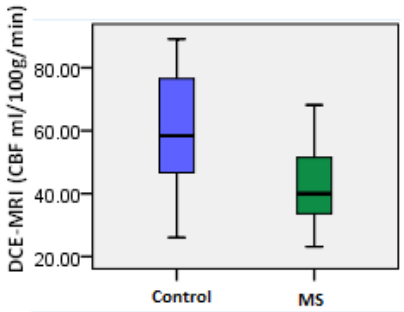

Figure 2. DCE-MRI comparison revealed significant difference in CBF between MS and controls (p=0.001)

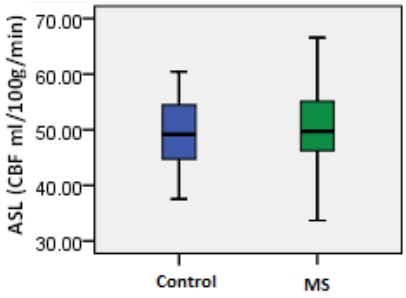

Figure 4. ASL comparison revealed no significant difference between MS and healthy controls in the basal ganglia

Discussion and Conclusion: CBF measure from the BG made using ASL and DCE-MRI do not correlate and are not directly comparable in our cohort of MS patients and healthy controls. A group difference in BG CBF detected using DCE-MRI (which replicates findings of a previous study [2]) was not found when using ASL perfusion data. Our findings suggest that DCE-MRI is more sensitive than this implementation of ASL in measuring perfusion in multiple sclerosis, and that researches should be cautions when comparing perfusion studies in MS that use different perfusion techniques.

References

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