Dual-vendor comparison of arterial spin labeling with same labeling and readout modules

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Purpose Arterial spin labeling (ASL) has shown to produce robust cerebral blood flow (CBF) measurements within acceptable scanning times[1]. Implementation into large multi-center studies seems to be the next step, which may eventually lead to the use of ASL as a clinical biomarker[2]. However, one main obstacle that impedes multi-center studies is the large heterogeneity in labeling and readout implementations between vendors. The current study compares 3T pseudo-continuous ASL (pCASL) CBF-measurements acquired at two major vendor MRI systems: Philips and Siemens. For this study, pCASL sequences were created with near complete similarity between the two vendor systems.

Methods Four healthy volunteers (2m/2f, age 26.5 ± 2 yrs) were scanned twice, alternately at a Philips- (Achieva, Philips Healthcare, Best, the Netherlands) and at a Siemens-scanner (Skyra, Siemens Healthcare, Erlangen, Germany) within 3 hours. Inter-session time differences were 104 ± 38 min. Identical readout details included: 2D gradient-echo EPI; voxel-size 3.5x3.5 mm in a 224x224 mm field of view; 20 ascending 6 mm slices; TE/TR 21/4700 ms; NSA 40; duration 6:16 min. The labeling details were: labeling duration 1800 ms, post-labeling delay 1771 ms, 1.17 ms pulse interval, 25 degree flip angles, gradient strength 6 mT/m, mean gradient 0.6 mT/m. All images were acquired without background suppression, parallel imaging acceleration or vascular crushing. Perfusion-weighted maps were quantified using a single compartment model[2] with the mean control image as equilibrium magnetization (M0). Inter-vendor differences in mean, variance and within-subject coefficient of variation (wsCV) of CBF were analyzed for the total cerebral GM and white matter (WM). Individual GM and WM CBF histograms were averaged for all subjects and both sessions.

Results On visual inspection on a single subject level (Figure 1), the CBF maps from both vendor systems yielded similar results with respect to the GM-WM CBF contrast as well as the contrast within the GM. The qualitative similarity is confirmed by the mean GM and WM histograms (Figure 2), which were nearly identical. However, an inter-vendor bias of the mean GM and WM CBF could be observed -- as is also shown by the Table.

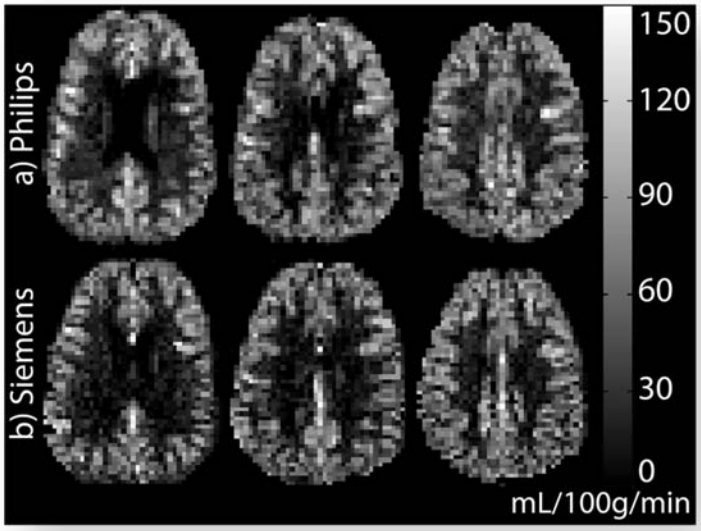

Figure 1 shows three consecutive transversal cerebral blood flow slices of a single subject for a) Philips and b) Siemens, without registration.

Discussion The CBF maps, histograms and GM-WM CBF ratios all appear similar for both vendors. In addition, the intra-vendor wsCVs are much lower compared to previous studies1, which may be due to low physiological variation. Despite these similarities, the differences between inter- and intra-vendor ΔCBF and wsCV indicate that residual inter-vendor differences remain to be solved. These results suggest that a common implementation from all vendors would facilitate multi-site studies. Currently, this study is extended with a third major vendor (General Electric). Data from the three-vendor comparison will be available by January 2014.

	Philips (n=4)	Siemens (n=4)	Between (n=8)
GM CBF (mL/100g/min)	75.6 ± 6.3	66.9 ± 3.7	71.2 ± 4.2
GM ΔCBF	4.0	-1.8	8.7
GM wsCV (%)	3.9	4.0	8.7
WM CBF (mL/100g/min)	22.3 ± 2.0	19.4 ± 1.6	20.9 ± 1.8
GM-WM CBF ratio	3.4 ± 0.1	3.5 ± 0.1	3.4 ± 0.2

Table Inter-session statistics of the two-vendor comparison. wsCV: within-subject coefficient of variation.

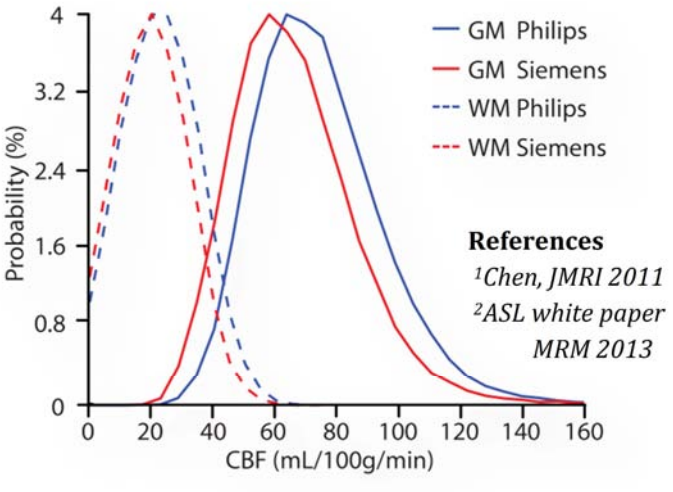

Figure 2 (on the right) shows the mean individual cerebral blood flow (CBF) histograms of both sessions (n=8) for both vendors, for gray matter (GM) and white matter (WM)

Acknowledgments This study was initiated within the European COST-ASL Initiative in Dementia action (BM1103).