Inter-vendor reproducibility of arterial spin labeling cerebral blood flow measurements at 3T

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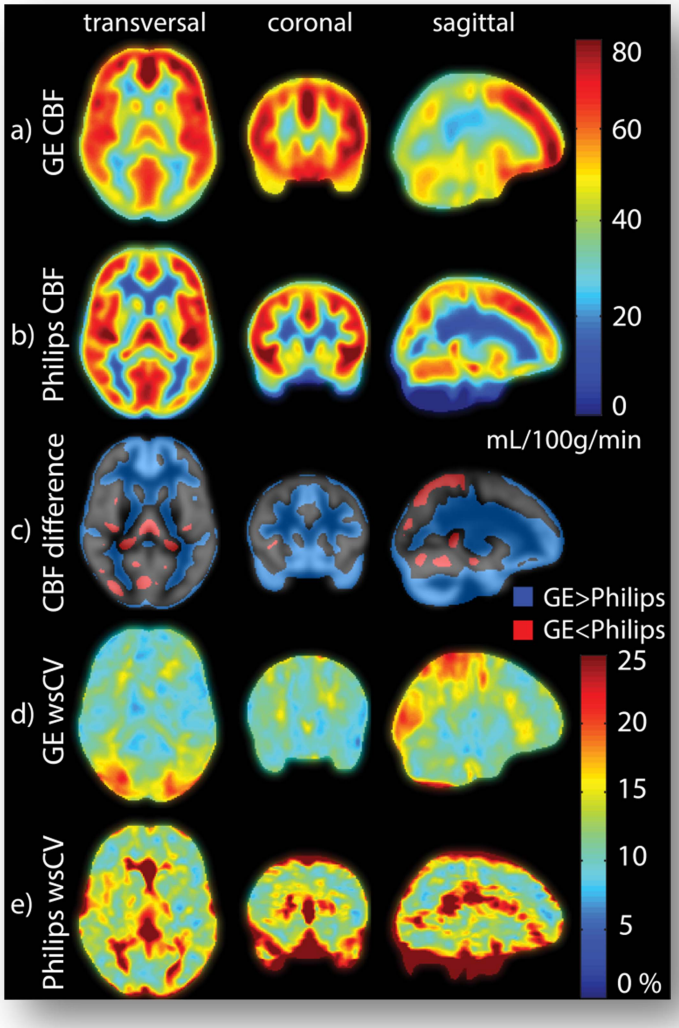
Introduction Arterial spin labeling (ASL) has shown to produce robust cerebral blood flow (CBF) measurements within acceptable scanning times[1]. Implementation into large multi-center studies seems to be the next step, which may eventually lead to the use of ASL as a clinical biomarker[2]. However, one main obstacle that impedes multi-center studies is the differences that exist between ASL implementations between MR vendors. It is currently unclear to what extent ASL-scans from different vendors can be combined and whether CBF values can be compared across platforms. The current study compares 3T pseudo-continuous ASL (pCASL) CBF-measurements acquired in two centers, at a General Electric (GE) and Philips scanner.

Methods 22 healthy volunteers (9 male, age 22.6 ± 2.1 years) were scanned twice at a GE- (Discovery MR750, GE Healthcare, WI, US) and Philips-scanner (Intera, Philips Healthcare, Best, the Netherlands). Sessions were separated by 1-4 weeks. For both scanners we chose the state of the art pCASL protocols that are currently used in clinical studies. The main difference between the GE and Philips acquisitions was the readout module: 3D vs. 2D. Further imaging details included for GE: 3D FSE stack-of-spirals; 8 arms with each 512 sampling points, voxel-size 3.75 mm isotropic in a 24 cm isotropic field of view (FOV); 36 slices; TE/TR 10.5/4600 ms; 3 NEX; total duration 4:29 min and for Philips: gradient-echo single shot EPI; SENSE 2.5; voxel size 3x3x7 mm; FOV 24x24 cm; 17 slices; TE/TR 17/4000 ms; 33 NEX; total duration 4:33 min. All images were acquired with background suppression and a 1525 ms post-labeling delay. All maps were registered to standard space to evaluate spatial differences of CBF and within-subject coefficient of variation (wsCV). In addition, inter-vendor differences in mean and variance of CBF were analyzed for the total cerebral gray matter (GM) and white matter (WM) (Table). Significant differences between means and variances were tested with a paired t-test and Levene's test respectively.

Results Spatial inter-vendor CBF and wsCV differences (Figure a-c and d-e respectively) were observed in the white matter, and in anterior, superior and inferior GM regions, and in the posterior vascular territory and superior watershed region. Figure c shows significant inter-vendor CBF differences (t-test). Whereas the mean GM CBF of both vendors was almost equal (Table, p=1.0), the mean WM CBF was significantly different (p<0.01). However, there were no significant differences between the intra-vendor GM variances (p=0.6), or between the inter-vendor GM variance and intra-vendor GM variances (p=0.3 and p=0.5 for GE and Philips respectively).

Discussion The observed spatial differences can be explained by readout differences such as increased smoothening in 3D, 2D susceptibility artifacts in combination with differences in post-labeling delay (fixed for GE versus caudo-cranial increase for Philips). Despite these spatial differences, there was no difference in the mean and variance of the total GM CBF. These results indicate that the total cerebral GM CBF can be compared between vendors, but that comparisons in the WM or in small GM regions are hampered by readout differences between vendors. Therefore, standardization of ASL implementation among vendors is strongly encouraged.

Table	GE (n=22)	Philips (n=22)	Between (n=44)
GM CBF (mL/100g/min)	65.9 ± 6.7	65.9 ± 9.0	65.9 ± 7.7
GM ΔCBF	- 0.4	3.9	0.0
GM wsCV (%)	8.9	9.9	11.1
WM CBF (mL/100g/min)	30.5	15.4	22.9
WM ΔCBF	-0.6	1.0	15.0
WM wsCV (%)	9.7	10.9	12.2
GM-WM CBF ratio	2.2 ± 0.2	4.3 ± 0.4	2.9 ± 0.2



References [1]*Gevers, JCBFM 2011* [2]*Li, ActaRadiol 2011*