Continuous Arterial Spin Labeling (CASL) in clinical practice at 3.0 T - Results on Reliability and Quantification

C. A. Manka[1], F. Traeber[1], W. Block[1], L. Scheef[1], J. Gieseke[2], C. Kuhl[1], H. Schild[1]
[1]Radiology, University of Bonn, Bonn, NRW, Germany, [2]Philips Medical Systems, Best, NL, Netherlands

Introduction:

Continuous Arterial spin labeling (CASL) is a known alternative to DSC (Dynamic Susceptibility Contrast), where the T1 relaxation of magnetized "labeled" protons are used as a freely diffusible intrinsic contrast medium. The positive aspect of this method is that the absolute cerebral blood flow (CBF) can be quantified (1). Due to its dependence on the T1 relaxation time of the blood and the SNR, the acquisition was highly time consuming und the brain coverage limited to a small number of slices at field strengths up to 1.5 Tesla. These boundaries restrict the common use of CASL in clinical diagnostics and should be improved by using clinical high field MRI scanners for CASL (2).

Goal:

In order to explore new opportunities at high field, especially at a clinical whole body 3 Tesla systems it seamed necessary to evaluate the "Single Coil CASL" technique in a clinical setting concerning reliability and quantification of this technique.

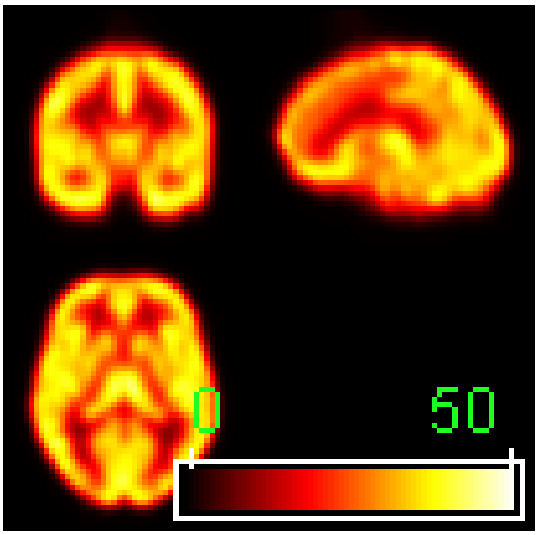
Material and Method:

Prospective continuous arterial spin labeling (CASL) perfusion study during routine clinical examinations in patients and volunteers at 3 Tesla MRI. The datasets were analyzed regarding the image quality, motion artifacts and quantitative values in normal white and gray matter and pathologies. All 154 examinations on patients and volunteers (mean age 35 +/- 17) were conducted at an Intera 3.0T MR System (Philips Medical Systems, Best, The Netherlands) using a standard Transmit / Receive Head Coil for single coil CASL (3) . A SSH – SE EPI Sequence (TR/TE 4000-4500 / 37-39ms, 11-17 slices, thickness 5-8mm, matrix 64x64, "labeling delay" 700-1200ms, 20-50 dynamic scans, max. scan time 6min) was used.
All CASL datasets were analyzed for motion using a Pride / IDL CASL-Tool (PMS, Best, NL / Idl. Inc., USA). Prior to calculation of CBF maps (LCQP-CASLTools, Radiology University of Bonn, Germany – based on Wang et al (4)), all acquired datasets were realigned using the SPM2 package (Wellcome Department of Imaging Neuroscience, GB). A visual grading of the CBF Maps was performed using a 3-point scale (not diagnostic, adequate, and good) and the datasets were analyzed regarding motion artifacts. An automated ROI analysis was performed on spatially normalized CASL CBF maps in cortex and white matter, the unit of cerebral perfusion is ml /min /100g.

Results:

The visual grading showed that 115/154 (74%) datasets were of good diagnostic quality. 21/154 (14%) datasets were of adequate diagnostic quality, whereas 18/154 (12%) datasets were not of diagnostic quality. A decreased diagnostic quality was in the majority of cases (32/154) due to motion, and only in 3 cases due to technical problems during acquisition. A mean CBF in the white matter of 14 ml/ min / 100g (SD +/- 2.6) and a mean CBF of 36 ml / min / 100g (SD +/- 4.3) was calculated for the cortex (Fig.1). The resulting grey/white matter ratio of was approx. 2.5.

Fig.1



Mean soothed and normalized CASL CBF-Map calculated using SPM2 (n=60)

Conclusion:

Single Coil CASL can be used reliable in clinical routine at 3.0 Tesla. Image quality of the CASL-Perfusion maps was of diagnostic value in the majority (88%) of the examinations.

Reference:

1. Floyd TF et al. (J Magn Reson Imaging. 2003 Dec;18(6):649-55)
2. Wang J et al. (Magn Reson Med. 2002 Aug; 48(2):242-54)
3. Oguz KK et al. (Radiology 2003 May; 227(2):567-74. Epub 2003 Mar 27)
4. Wang J et al. (Magn Reson Med. 2003. 50:599-607. Page 600)