# Assessment of cerebral perfusion in ischemia patients using multi-TI ASL and DSC

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**Target audience:** Scientists and radiologists interested in application of perfusion MR imaging.

**Purpose:** Using multi-TI arterial spin labeling sequence with 3D GRASE readout for perfusion imaging in ischemic stroke to calculate the relative cerebral blood flow (relCBF) and bolus arrival time (BAT), and to compare with dynamic susceptibility contract perfusion weighted MR imaging (DSC).

**Methods:** 15 patients with ischemic stroke were examined using 3D multi-TI ASL, and 9 of them were also examined by DSC MRI on a 3T MR scanner (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany) with a 20-channel head-neck coil. The prototype 3D multi-TI ASL sequence was used with following parameters: FOV = 220×220 $mm^2$, matrix = 128×128, slice thickness = 6 mm, slices = 24, TR/TE = 3200/26 ms, 8 TIs from 500 to 2800 ms. The total acquisition time was 4:32 min including an M0 scan. The Buxton model with a non-linear fit to relCBF and BAT was used for quantification. DSC images were scanned using a 2D GE-EPI sequence and the parameters were: FOV = 220×220 $mm^2$, matrix = 128×128, slice thickness = 6 mm, slices = 8, TR/TE = 1870/30 ms, FA = 90 deg, and 60 measurements. The relCBF and BAT maps were calculated from the perfusion weighted series using software PMA (Perfusion Mismatch Analyzer, http://asist.umin.jp/). Mean values of relCBF and BAT by ASL and DSC were extracted from ischemic lesion region of interests (ROIs) and the contralateral mirror ROIs. Lesions with large fitting error for ASL were excluded. Pearson correlation was used for analysis of the normalized relCBF and BAT from ASL and DSC [1].

**Results:** 6 patients with large fitting error in the ischemic lesions were excluded from final analysis. All ischemic lesions showed hypoperfusion in relCBF and hyperintensity in BAT maps from both multi-TI ASL and DSC. However, some of the lesions with lower perfusion had fitting errors in the BAT maps from the multi-TI ASL. The normalized relCBF values were 0.80±0.11 for ASL and 0.78±0.08 for DSC, and the normalized BAT values were 1.34±0.35 for ASL and 1.36±0.24 for DSC. ASL and DSC's relCBF and BAT values were found to be highly correlated (r=0.834, P=0.003 for relCBF; r = 0.870, p = 0.001 for BAT).

**Discussion and Conclusion:** ASL is an alternative noninvasive perfusion imaging method for children and patients with renal dysfunction. However, ASL using *single* TI suffers from artifacts and quantification errors caused by delay time variation. Multi-TI ASL- instead – could significantly improve the quantitative perfusion parameters, from which the clinical diagnostic accuracy can benefit.

**Ref:** (1) Wang et al Eur Radiol 21 February 2014.

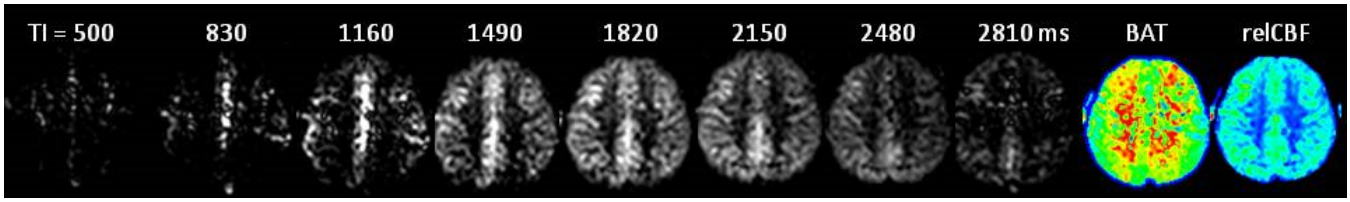


**Figure 1.** Perfusion weighted images from multi-TI ASL at different TI values in a healthy control subject. The BAT and relCBF maps were calculated from the perfusion weighted images.

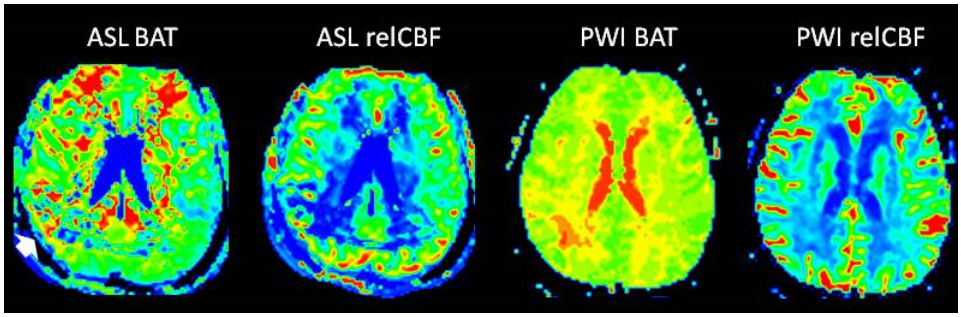


**Figure 2.** A 63-year-old female patient with ischemia lesion in the right parietal-occipital junction. The infarct shows hyperintensity on BAT, hypointensity on and relCBF images from multi-TI ASL and DSC.