THE COMPARISON OF ASL FEATURES BETWEEN YOUNG AND ELDERLY POPULATION: CLINICALLY FEASIBLE PARAMETER SETTING FOR LONG LABELED PSEUDO-CONTINUOUS ASL TO REDUCE THE SENSITIVITY OF DELAYED ARTERIAL TRANSIT TIME

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Target audience: Clinical researchers interested in ASL perfusion MRI

INTRODUCTION

Arterial spin labeling (ASL) is a means s of non-invasive MR perfusion assessment, which can provide a quantitative value of regional cerebral blood flow (rCBF). The signal intensity obtained by ASL depends on not only the perfusion signal, but also arterial transit time (ATT). ATT has a most significant effect on accurate rCBF calculations due to errors in fixed parameters. A previous study on reducing ATT sensitivity proposed the use of a long post-labeling delay (PLD) or correction of rCBF based on a multiple PLD approach [1]. However, because of the low signal-to-noise ratio (SNR) or long acquisition time, the simple multiple PLD approach is difficult to use in routine clinical examinations. The purpose of this study was to optimize imaging parameters for accurate rCBF using long labeling duration (LD) and long PLD with higher SNR, which may be acceptable for clinical practice.

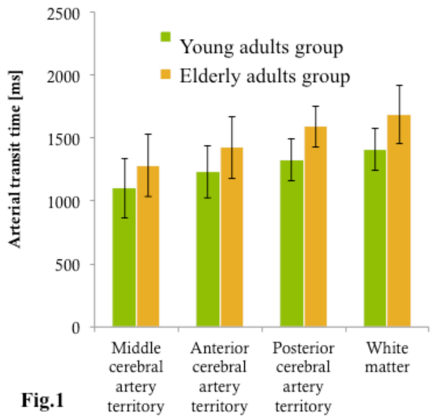

Fig.1

MATERIALS AND METHODS

First, the perfusion signal was simulated using a single-compartment model in each LD (1.5, 2.5, 3.5, and 4.5 s), and theoretical SNR efficiency (SNR_{eff}) was calculated [1]. Second, in vivo studies were performed on a Discovery 750 3.0T MRI scanner (GE Healthcare) with 32-channel head receiver coil. Fifteen volunteers were enrolled and categorized as young adults (n=5; mean age, 23.0 years) or elderly adults (n=10; mean age, 72.6 years). We then measured ATT using a low-resolution (612×2 arms) pre-scan approach with multiple PLD (0.70, 1.15, 1.60, 2.05, and 2.50 s) in each arterial territory in all volunteers [1]. Next, we evaluated both ΔM and SNR with three LDs (1.5, 2.5, and 3.5 s) in the young age group. Finally, we compared differences in rCBF values between with and without ATT correction among three combinations of LD and PLD (1. LD 4.0 s, PLD 0.7 s; 2. LD 3.5 s, PLD 1.5 s; 3. LD 4.0 s, PLD 2.0 s) in both age groups. The other imaging parameters were as follows: pseudo-continuous labeling with vessel suppression pulse and 3-dimensional FSE spiral acquisition, FOV=240 mm, TR/TE=5539/11.3 ms, 512×7 arms, NEX= 1, slice thickness=4.0 mm, 38 slices.

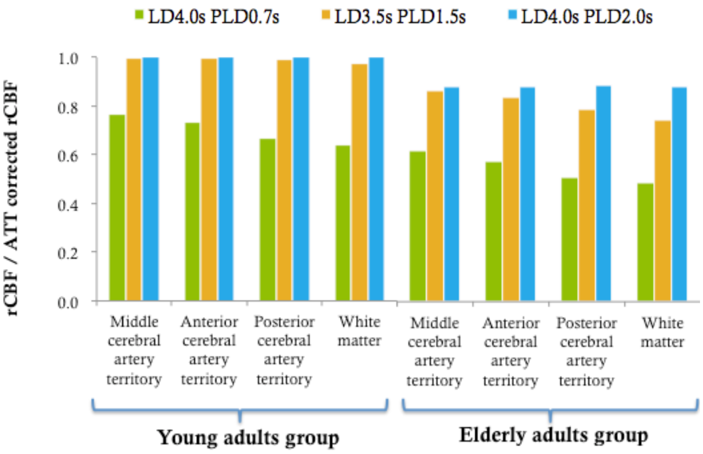

Fig.2 The ratio of CBF and ATT corrected CBF of each vascular territory

RESULTS

Regarding signal simulation, ΔM increased with longer LD. SNR_{eff} also improved with longer LD, but SNR_{eff} plateaued at LD=3.5 s. As for the in vivo study, ΔM and SNR of the perfusion image was increased in a linear manner with longer LD in young age. The elderly group showed a 0.23 s longer ATT on average compared the young group (Fig. 1). Although rCBF in the young adult group with LD 3.5 s and PLD 1.5 s was almost equal to that with LD 4.0 s and PLD 2.0 s in each vascular territory, differences in corrected rCBF values were larger in the elderly group (Fig. 2). This trend was greatly magnified in the longer ATT area. Figure 3 compares rCBF maps with and without ATT correction in both age groups.

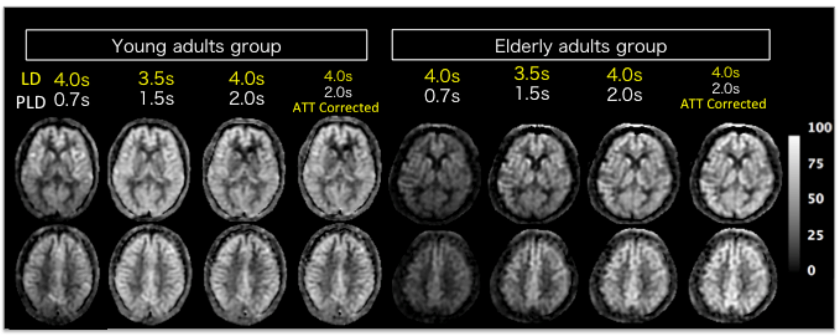

Fig.3 rCBF map obtained by each LD and PLD and ATT corrected rCBF map

DISCUSSION AND CONCLUSION

From the results of the in vivo study, a 2.0 s PLD should be employed for elderly individuals with long ATT. Based on our results, optimal imaging parameters suggested a combination of LD 3.0 s and PLD 2.0 s to improve rCBF quantification and allow sufficient SNR in elderly individuals with long ATT.

REFERENCES W. Dai et al., MRM 67:1252-1265, 2011