Multi-Slice Look-Locker FAIR for Hepatic Arterial Spin Labelling

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Target audience: This abstract will be of interest to those interested in arterial spin labelling, liver perfusion or liver disease.

Purpose: Arterial spin labelling (ASL) is used in the brain [1], heart [2] and kidney [1] to measure perfusion but has not yet found extensive utility in the liver, due to its dual vascular supply and susceptibility to respiratory motion. Non-invasive liver perfusion measurements could monitor hepatic disease progression and drug efficacy in pre-clinical models of cirrhosis [3] and tumour metastasis [4]. Previous work demonstrated single-slice Look-Locker Flow-Sensitive Alternating Inversion Recovery (FAIR) hepatic ASL measurements [5]; however a multi-slice perfusion sequence would increase efficiency of whole liver coverage when imaging multiple metastases and gross liver dysfunction. In this study we demonstrate the use of a multi-slice Look-Locker FAIR ASL and compare it to equivalent single-slice perfusion data.

Methods: ASL acquisition: Single slice perfusion measurements were obtained using a respiratory-triggered inversion, segmented FAIR Look-Locker ASL sequence with a spoiled gradient-echo readout [6]. The multi-slice sequence was adapted from the single-slice technique with additional segmented acquisition pulses for each slice within the Look-Locker train [7]. Multi-slice sequence parameters were: FOV 30 x 30 mm²; matrix size 128 x 128; 3x1 mm slices with 0.2 mm gap, TE 1.18 ms; TI 110 ms; TR 13 s; α,=8°; TR 15:10-27. Inversions were performed at the end of the inspiration phase. 2004; 15:10-27. [2] Belle V, Proc. Intl. Soc. Mag. Reson. Med. 21 (2013)

A

B

C

Discussion & Conclusions: Arterial spin labelling has been principally used for measuring brain perfusion [2], with more recent application to cardiac [3] and renal [4] imaging. We have previously shown the feasibility of localised liver perfusion measurements using FAIR-ASL [4], an application that has not been extensively reported in the literature, and here demonstrate an improvement to this technique with a multi-slice adaptation. For these data the multi-slice sequence offers a threefold increase in time efficiency for the same liver coverage as the sequence takes the same amount of time as a single slice acquisition (less than 15 minutes); the sequence could easily be adapted to cover more slices. The slight perfusion overestimation measured could be corrected with a more appropriate quantification method which accounts for inflowing blood magnetisation [5]. The perfusion maps generated are from a mixture of both the arterial and portal systems; a pseudo-continuous ASL method could be implemented to evaluate their respective contributions. Using this sequence, we aim to investigate perfusion changes in colorectal cancer metastasis induced by novel anti-cancer therapies. Furthermore, brain and kidney FAIR ASL is commonplace in clinical scanners, and given the non-invasive nature of the technique, we anticipate that translating hepatic multi-slice Look-Locker FAIR ASL into a clinical setting would be straightforward.

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Figure 1: Three T2-weighted, fast spin echo images of a liver at the different slice positions with the liver ROI outlined (Row A). Corresponding single-slice perfusion maps (Row B) and multi-slice perfusion maps (Row C). Visual inspection indicates good correlation between the two techniques; high flow can be seen at major blood vessels such as the portal vein (long arrow) and inferior vena cava (short arrow).