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Reduced Acquisition Time PET/MR Quantification: a comparison of tracer delivery estimation methods

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Due to the long acquisition time required for dynamic PET with pharmacokinetic (PK) modelling, the statically acquired standardised uptake value ratio (SUVR) is commonly used. However, SUVR is sensitive to blood flow changes which confound longitudinal studies. We have proposed a framework to incorporate cerebral blood flow (CBF) from arterial spin labelling (ASL) MRI into the PK modelling to halve the acquisition time from 60 to 30 mins using a simultaneous PET/MR acquisition. This framework requires the conversion of ASL-CBF into the PET tracer delivery parameter (R1), which is then fixed for PK modelling of the 30 mins of PET data. In this work we compare three methods for estimating PET-R1 from ASL-CBF data: linear regression (LR), image fusion (IF) and deep learning (DL), and assess the influence of the resulting R1 errors on the estimation of target density (BPND). This was applied to an amyloid-beta targeting PET tracer, used in the imaging of Alzheimer's Disease. Analysis on 32 subjects showed that the IF and DL methods outperformed the global LR method as they utilise local structural information to derive R1. Despite the improved R1 estimation, DL has a similar error to IF for BPND, suggesting that these methods are approaching the upper limit for this short acquisition PET/MR framework.

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