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(G*) (POS-45) Applying the Hybrid PET/MRI Technique PMROx in Healthy Humans to Measure Cerebral Metabolic Rate of Oxygen

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Introduction
Positron Emission Tomography (PET) is the gold standard for imaging CMRO2, the cerebral metabolic rate of oxygen (Fan et al., NeuroImage, 2020). However, the procedure requires up to three radiotracers and invasive arterial sampling. Incorporating MRI techniques can simplify the procedure (Ssali et al.,JNM, 2018; Narciso et al., Phys Med Biol, 2021). PET/MR imaging of oxidative metabolism (PMROx) uses whole-brain (WB) CMRO2 measured by MRI to calibrate simultaneously acquired [15O]O2-PET data, eliminating arterial sampling. Arterial spin labeling (ASL) can be used to replace [15O]H2O-PET, reducing the requisite number of radiotracers to one. PMROx is non-invasive yet maintains the ability of PET to quantify the oxygen extraction fraction (OEF). CMRO2 can be imaged under different metabolic states (e.g., rest and during a functional task) in a single imaging session as the acquisition time is ˜5 min. The accuracy of PMROx was previously demonstrated in a porcine model (Narciso et al., JNM, 2021). The aim of the current work was to present initial data translating PMROx to human participants.
Methods
Data were acquired from n=13 healthy subjects on a Siemens 3T Biograph mMR scanner. Five minutes of list-mode PET data were acquired after inhalation of ˜2000 MBq of [15O]O2 while measuring WB CMRO2 by MRI (Jain et al., J Cereb Blood Flow Metab, 2010) at rest and during a finger-tapping task. PET images were reconstructed using MR-based attenuation correction maps, motion-corrected, and smoothed by a 4mm Gaussian filter. Pseudo-continuous ASL (TR/TE: 4210/37.86 ms, post-labeling delay: 1.7s, labeling duration: 1.5s) was collected during the PET acquisition. ASL images were motion-corrected and smoothed by a 6mm filter. All images were pre-processed in SPM12 and calculations were completed with in-house MATLAB scripts.
Results
Results were normalized to Montreal Neurological Institute (MNI) atlas space. Average resting CMRO2 across subjects was 4.5 and 3.5 mL/100g/min for grey and white matter, respectively. CMRO2 was observed to increase ˜25% in the motor cortex during tapping.
Discussion
This preliminary study demonstrates the feasibility of imaging CMRO2 in a span of 5 minutes by combining [15O]O2-PET with MRI, reducing the requisite number of radiotracers to one and eliminating arterial sampling. CMRO2 values were in good agreement with literature values.

Keyword-1

PET/MRI

Keyword-2

Cerebral Metabolic Rate of O2

Keyword-3

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