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(G*) Simultaneous Hyperpolarized 129Xe MRI and [15O]water PET Multi-Modal Imaging: A Proof of Concept Study

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Introduction: A non-invasive imaging method: inhaled hyperpolarized (HP) 129Xe magnetic resonance imaging (MRI) is currently used to measure lung structure and function.***1*** Simultaneous ventilation/perfusion (V/P) lung measurements of functional gas exchange within the lungs can be obtained using this MRI approach because of the high solubility of xenon in lung tissue as compared to other imaging gases. This measurement is possible due to the distinct and large range of chemical shifts (˜200ppm) of 129Xe when residing within barrier and RBC (e.g., barrier and RBC phase xenon) compared to the gas phase. Therefore, 129Xe is a unique probe for exploring xenon within and beyond the lung, such as lung parenchyma (barrier), RBC, and even other organs such as the **brain**, heart and kidney.
[15O]water positron emission tomography (PET) is the gold standard imaging method for determining cerebral perfusion.***2,3*** In this study, simultaneous 129Xe-based MRI and [15O]water PET images were collected and compared.

Methods: A 60mL plastic syringe was used in which 30mL of the hyperpolarized 129Xe gas was dissolved in [15O]-water solution (30mL) After dissolving, all leftover xenon gas was removed from the syringe. A turn-key, spin-exchange polarizer system (Polarean 9820 129Xe polarizer) was used for obtaining Hyperpolarized 129Xe gas. 129Xe dissolved phase images were acquired in a 3T PET/MRI (Siemens Biograph mMR) scanner. [15O]water PET data were acquired simultaneously with 129Xe MRI using the integrated PET system in the 3T PET/MRI.

Results: Two consecutive 2D axial 129Xe MRI images and two (2D and 3D) [15O]water PET images were acquired simultaneously. 129Xe/PET images indicate that the diameter of the phantom from both PET and MRI images are similar. Both 129Xe images demonstrate a sufficient SNR level (80 and 10 respectively) suggesting that 3D 129Xe imaging is possible.

Conclusions: The results of this proof-of-concept study clearly indicate the feasibility of the simultaneous hyperpolarized 129Xe MRI and [15O]water PET measurements. This demonstration enables the next step, namely, in-vivo double tracer brain perfusion imaging which we plan to perform using a small animal model.

References:
1.Kaushik, S. S. et al. MRM (2016); ***2***. Fan, A., et. al. JCBFM (2016); ***3.*** Ssali. T., et. al. JNM (2018).

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