

Xenon-129 Hyperpolarised MRI Using A Open Design, Upright, Clinical Scanner

James Harkin, Robert Irwin, Shahideh Safavi, Brett Haywood, Andrew Peters, Ian Hall and Michael Barlow

Hyperpolarised lung imaging has the potential to revolutionise how chronic respiratory diseases are both diagnosed and their progress is monitored. High resolution images can be obtained without the ionising radiation associated with CT. Images have shown great detail inside the lungs, including differences between healthy volunteers and patients with specific respiratory conditions¹. Xenon is also highly soluble; it diffuses readily from the air spaces of the lungs into the lung parenchyma and blood. It's high chemical shift means that a magnetic resonance spectrum from the lungs contains multiple peaks, corresponding to Xenon dissolved in to different compartmental phases. Imaging the uptake of Xe can provide functional lung data, which is location dependant².

However, it has been shown that lung function and volume, as well as arterial oxygen levels are affected by body position³. The lungs and diaphragm are acted on by gravity differently when supine vs upright. By lying supine lung function is reduced and for patients at the latter stages of chronic conditions, such as COPD, many simply can't lay in a supine position for an extended period of time. Even for those in the early stages, the breath hold requirements of the experiment can be difficult. Furthermore, it seems logical to extend studies to an upright orientation as the lung mechanics and function are different, yet represent a majority of time in the woken state.

The multinuclear 0.5T Paramed Medical Systems MROpen Upright MRI scanner (Fig.1) is the first of its kind. Two parallel TechMag Redstone spectrometers allow for both proton and xenon imaging. The subject can be imaged in a variety of positions, including supine, seated or standing. The open design is also excellent in terms of patient experience; claustrophobic reactions are virtually eliminated and the easy access and different orientations can be exploited to make the scanner better suited to disabled or paediatric cohorts.

Using the Paramed MRI scanner a ¹²⁹Xe surface coil was tuned and Xenon images were obtained as well dissolved phase signals in multiple media. We will present preliminary data of volunteers in both supine and upright positions.



1) Dregely I, Mugler JP, Ruset IC, et al. Hyperpolarized Xenon-129 gas-exchange imaging of lung microstructure: first case studies in subjects with obstructive lung disease. *J Magn Reson Imaging*. 2011;33(5):1052-62.

2) Mugler JP, Altes TA. Hyperpolarized ¹²⁹Xe MRI of the human lung. *J Magn Reson Imaging*. 2013;37(2):313-31.

3) Kuethe DO, Filipczak PT, Hix JM, et al. Magnetic resonance imaging provides sensitive in vivo assessment of experimental ventilator-induced lung injury. *Am J Physiol Lung Cell Mol Physiol*. 2016;311(2):L208-18.

Fig.1: Paramed Medical Systems MROpen Upright MRI Scanner