Abstract 41761
Imaging the Effect of Airway Opening in Asthma due to Inflation State with 3He MRI

Type: Scientific Abstract

Category: 08.05 - Imaging: Physiologic and Clinical Correlates, Animal Models, and Emerging Technologies (RSF/CP)

Authors: H. Marshall¹, S. Siddiqui², G. Leung¹, J. Parra-Robles¹, X. Xu¹, C. Brightling², J. Wild¹; ¹University of Sheffield - Sheffield/UK, ²University of Leicester - Leicester/UK

Abstract Body

Rationale Airway inflammation and remodelling in asthma make both large and small airways susceptible to closure [1]. The spatially-localised nature of airway closure makes imaging desirable for its assessment in vivo, and measurement of air-trapping in CT (caused largely by airway closure) has been found to be associated with severe asthma [2]. Hyperpolarised ³He MRI is sensitive to regional ventilation changes and is non-ionising. Lung inflation volume is related to airway closure, and volumes below residual volume (RV) have previously been shown to induce airway closure in elite divers [3]. Images acquired at functional residual capacity (FRC)+1L and total lung capacity (TLC) show uniform ventilation in healthy volunteers. Here we aimed to visualise the effects of regional airway opening and closure in asthma by imaging ventilation at different lung inflation states using hyperpolarised ³He MRI.

Methods 10 patients with asthma were scanned using a 1.5T whole body MRI system. FRC+1L images: A mix of 350mL hyperpolarised ³He and 650mL N₂ was inhaled from FRC. ³He breathhold ventilation images were acquired with full lung coverage and a spatial resolution of 3x3x10mm. During the same breath-hold, low-resolution ¹H images of anatomy were also acquired [4]. TLC images: With the patient in the same position, a mix of 400mL hyperpolarised ³He and 600mL N₂ was inhaled from FRC, and then the patient inhaled room air to total lung capacity (TLC). ³He ventilation images and low-resolution ¹H anatomical images were acquired during the breath-hold.

Results Ventilation distribution differences between FRC+1L and TLC were seen in 8 of the 10 asthmatics scanned. ³He ventilation images from 2 asthmatics are shown in figure 1; there were multiple small ventilation defects visible at FRC+1L which resolved at TLC.

Figure 2 shows ventilation in blue and anatomy in gray. Defects in the lower lung present at FRC+1L become more ventilated at TLC, increasing the percentage of ventilated lung. The spatially and temporally matched anatomical images confirm the position of the ventilated tissue in relation to the lung border at the different inflation states.
Conclusions $^3$He MRI is sensitive to ventilation changes between FRC+1L and TLC in asthmatics. Effects due to lung inflation state were visualised at the segmental and sub-segmental level, consistent with airway closure and opening in large and small airways.

Acknowledgements EU AIRPROM-FP7 project.