

**Purpose:** Our objective was to develop novel non-invasive pulmonary proton magnetic resonance imaging (1H MRI) for simultaneous regional evaluation of lung function and structure in smoking-related lung disease. Currently there is no pulmonary structure/function 1H MRI technique that can be made universally available for conventional clinical MRI systems. We focused on short echo time (TE) and Fourier-decomposition (FD) methods providing critical technological steps required to develop lung 1H MRI for therapy guidance.

**Methods:** In this pilot study, nine healthy never-smokers and 11 COPD subjects underwent same-day plethysmography, spirometry, short echo time ((TE) =1.2ms) 1H and hyperpolarized 3He MRI at 3.0T. High resolution x-ray computed tomography (HRCT) was also performed to measure the relative area less than 950 Hounsfield units (HU) (RA950) and lung density at the 15th percentile (HU15%).

**Results:** We showed the feasibility of FD 1H MRI to obtain lung ventilation maps and also showed that 1H MRI signal intensity (SI) was significantly correlated with 3He apparent diffusion coefficients ADC ( $r=-.58$ ,  $p=.008$ ), CT measurements of emphysema (RA950  $r=-.69$ ,  $p=.02$  and HU15%,  $r=.66$ ,  $p=.03$ ) and conventional measurements of pulmonary function.

**Conclusions:** These findings suggest 1H MRI can be developed as a non-invasive structure/function imaging tool for monitoring lung disease. Pulmonary lung structure/function 1H MRI requires minimal patient compliance, can be accomplished in less than 5 minutes of image acquisition time and is not dependent on gating techniques, creating an opportunity for serial studies of lung functional changes in lung cancer and COPD.