REGIONAL PULMONARY VENTILATION ASSESSMENT WITH MRI

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Obstructive lung disease (OLD) is a category of respiratory diseases that include asthma, chronic obstructive pulmonary disease (COPD), and bronchitis/bronchiolitis. Current prevalence is estimated at 8-14% in the USA and Great Britain. Cystic Fibrosis (CF) is a multi-system disorder occurring in 1 in 3000 births among populations of European descent caused by a mutation in the cystic fibrosis transmembrane conductance regulator (CFTR) gene. Nuclear Scintigraphy, Positron Emission Tomography, Single Photon Emission Computed Tomography, and Magnetic Resonance Imaging have all demonstrated potential to characterize regional lung disease, but to date, none have emerged as a forerunner as a robust and clinically translatable technique. The purpose of this work is to demonstrate the feasibility of oxygen-enhanced MRI with an ultra-short echo time radial acquisition for the evaluation of regional lung disease. To this end, the robustness and reproducibility of a hyperpolarized ^{3}He MRI acquisition for use as an imaging reference standard for comparison is first demonstrated. Next, the theoretical underpinnings of oxygen-enhanced MRI are explored and validated in a healthy normal subject pool. Finally, a comparison between oxygen-enhanced and hyperpolarized ^{3}He MRI is performed in a Cystic Fibrosis lung disease group. This dissertation lays the groundwork for a 3D radial oxygen-enhanced MRI technique that is has strong potential for clinical translation.