Title: Investigating Sex Differences in COPD and Bronchiectasis Using CT Vascular Structure and MRI Ventilation

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Structured Abstract:

INTRODUCTION: In approximately 50% of COPD patients, there is CT evidence of bronchiectasis characterized by abnormal airway dilatation, destruction and mucous plugging that are believed to result from recurrent infection. With highly heterogeneous morbidity and disease progression, this disease also presents a sexually dichotomous bias against females that is poorly understood. Previous work showed that hyperpolarized gas magnetic resonance imaging (MRI) ventilation abnormalities were spatially related to abnormally remodelled airways in patients with bronchiectasis. Moreover, in COPD patients, an increased broncho-arterial (BA) ratio measured using thoracic computed tomography (CT) appears to be driven by small artery abnormalities. The objective of this preliminary study was to investigate potential relationships between CT pulmonary vascular tree measurements and MRI ventilation in patients with COPD and bronchiectasis. We hypothesized that decreased pulmonary vessel volume would be significantly different in patients as compared to age-matched health volunteers.

METHODS: Participants provided written informed consent to an ethics-board approved protocol and underwent thoracic CT and hyperpolarized 3He MRI as previously described. MRI ventilation defect percent (VDP) and CT total blood vessel volume (TBV) were quantified using in-house algorithms. TBV and VDP were generated using a lobar CT mask (VIDA Diagnostics Inc., Coralville, IA). Relationships were determined using linear regression and ANOVA tests were used to determine significant differences (Graphpad Prism version 7, La Jolla, CA). TBV was also quantified using software developed at Brigham and Women’s Hospital (Boston MA) through Chest Imaging Platform, as well as the volume of small vessels within the lung, normalized to TBV, with a diameter of <5mm (%TBV) or between 5 and 10mm (%BV10).

RESULTS: We evaluated 44 participants (70±9 yrs) including 15 bronchiectasis (69±11yrs), 14 COPD chronic bronchitis (69±8yrs) and 15 never-smoker participants (72±7yrs). VDP and TBV were significantly different between subgroups. VDP was significantly related to TBV, but this relationship appeared to be driven by lung volume. Despite a small sample size, we also observed differences between males and females for TBV, %BV5 and VDP.

CONCLUSIONS: In a small group of healthy volunteers, patients with mainly chronic bronchitis COPD (small airways disease and not emphysema) and bronchiectasis, pulmonary vascular volume measured using CT was moderately related to ventilation abnormalities measured using MRI. There were significant differences between the age-matched healthy volunteers and patients. Future work will include an investigation of these parameters in a larger cohort of COPD patients (TINCan). Regional analysis of the spatial correlations between ventilation abnormalities and vascular tree patency is required.