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Comparison of in-vivo lung morphometry models from multiple b-value diffusion-weighted MRI in healthy controls, IPF and COPD patients

Morphology, Imaging

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Introduction

Two models of gas diffusion MRI, namely the cylinder model (CM) [Yablonskiy, D. A., et al. (2002). PNAS 99(5)] and the stretched exponential model (SEM) [Parra-Robles, J., et al. (2014). Proc ISMRM:3529], have been proposed for quantitative measurement of alveolar microstructural length scales (L_m for CM and Lm_D for SEM) from multiple b-value hyperpolarised gas diffusion-weighted (DW) MRI.

Aims

Evaluate and compare estimates of lung morphometry from two models of ^{3}He gas diffusion in healthy controls, idiopathic pulmonary fibrosis (IPF) and chronic obstructive pulmonary disease (COPD) patients.

Methods

46 subjects underwent multiple b-value ^{3}He DW-MRI: 19 healthy controls, 13 IPF and 14 COPD patients. Maps of L_m and Lm_D values were generated

using the CM and SEM respectively, and mean values for each subject were derived.

Results

A statistically significant difference ($p<0.001$) was obtained between healthy controls and patient groups for both mean L_m and Lm_D values. Lm_D and L_m were significantly correlated ($p<0.001$) in a power relationship regression fit model ($R^2=0.957$) (Figure 1).

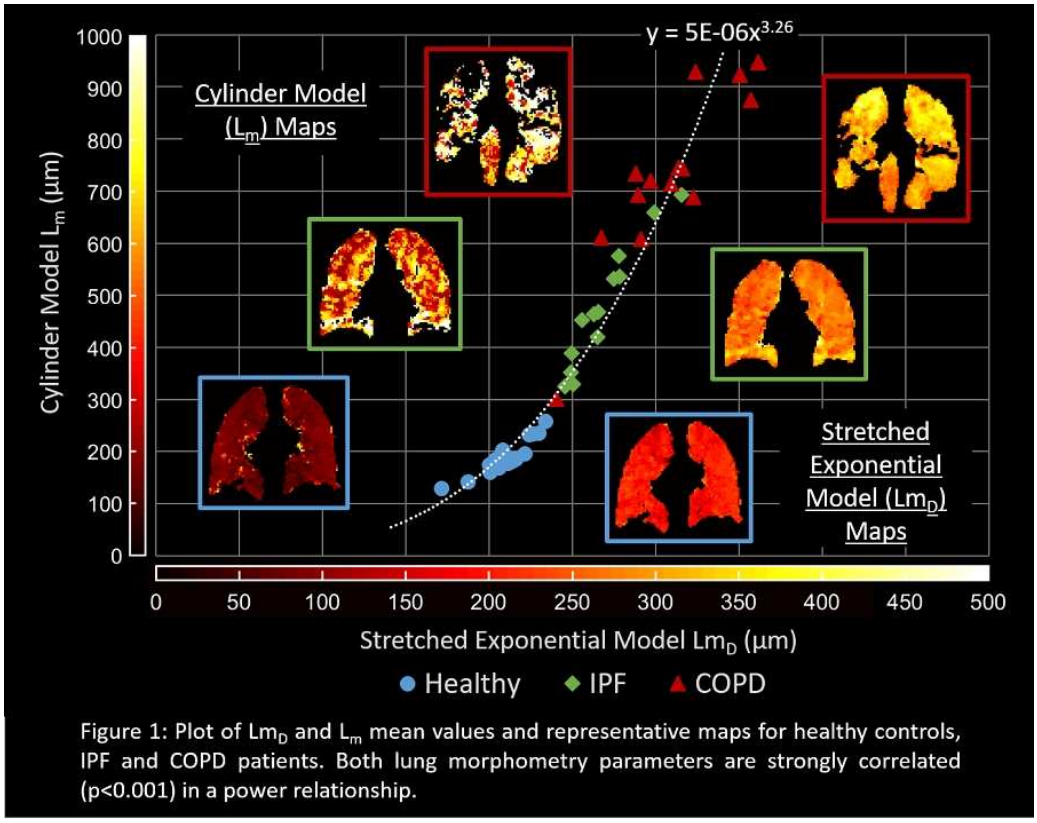

Figure 1: Plot of Lm_D and L_m mean values and representative maps for healthy controls, IPF and COPD patients. Both lung morphometry parameters are strongly correlated ($p<0.001$) in a power relationship.

Conclusion

The non-linear relationship observed results from inherent differences in

model assumptions. E.g. the CM is optimised for a limited range of alveolar diameters (<400 Mm), whereas SEM does not make geometrical assumptions and is potentially valid over a wider range of alveolar sizes.