European Respiratory Society
Annual Congress 2012

Abstract Number: 4465
Publication Number: P657

Abstract Group: 1.3. Imaging
Keyword 1: Physiology **Keyword 2:** Morphology **Keyword 3:** Lung mechanics

Title: Comparison of aerosol deposition pattern in healthy subjects: 3D SPECT measurements vs simulation results

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Body: Introduction A clinical study designed to validate computational models of aerosol deposition using controlled parametric experiments has been completed and the experimental conditions have been simulated using analytical models of aerosol deposition. Objectives For the modeling side of this study, the aim was twofold: (i) to introduce realistic asymmetric features in the description of the human respiratory tract and (ii) to compare the simulated aerosol deposition patterns within the lungs with measurements. Methods The 6 healthy subjects performed 2 inhalations each, which differed by a single controlled parameter: particle size, ventilation regime, or carrier gas. 3D Single Photon Emission Computed Tomography (SPECT) was performed to measure aerosol deposition location in the respiratory tract. An analytical model was used to mimic aerosol inhalation experiments and simulate particle deposition within the lungs. Simulations were performed using asymmetric lung morphologies based on patient's morphometric data extracted from High Resolution Computed Tomography images, such as length and diameter of the first airway generations, and lobar volumes (in terms of percentage of the functional residual capacity). Results Comparisons with experimental measurements have been done for total, tracheobronchial (TB) and lobar deposition, showing good correlation between measured and simulated values. For instance, mean experimental TB deposition fraction in the left lung is 14.5±2.4, vs. 14.9±4.1 for simulation results. Conclusions This work provides a scientific foundation for addressing both asymmetric and individualized lung morphologies in analytical modeling of aerosol deposition.