Abstract Submitted
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Correlation among regional ventilation, airway resistance and particle deposition in normal and severe asthmatic lungs[1] SANGHUN CHOI, ERIC A. HOFFMAN, The University of Iowa, MERRYN H. TAWHAI, The University of Auckland, CHING-LONG LIN, The University of Iowa — Computational fluid dynamic simulations are performed to investigate flow characteristics and quantify particle deposition with normal and severe asthmatic lungs. Continuity and Navier-Stokes equations are solved with unstructured meshes and finite element method; a large eddy simulation model is adopted to capture turbulent and/or transitional flows created in the glottis. The human airway models are reconstructed from CT volumetric images, and the subject-specific boundary condition is imposed to the 3D ending branches with the aid of an image registration technique. As a result, several constricted airways are captured in CT images of severe asthmatic subjects, causing significant pressure drop with high air speed because the constriction of airways creates high flow resistance. The simulated instantaneous velocity fields obtained are then employed to track transport and deposition of 2.5 μm particles. It is found that high flow resistance regions are correlated with high particle-deposition regions. In other words, the constricted airways can induce high airway resistance and subsequently increase particle deposition in the regions. This result may be applied to understand the characteristics of deposition of pharmaceutical aerosols or bacteria.

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