Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Correlations of Flow Structure and Particle Deposition with Structural Alterations in Severe Asthmatic Lungs[1] SANGHUN CHOI, SHINJIRO MIYAWAKI, JIWOONG CHOI, ERIC A. HOFFMAN, Univ of Iowa, SALLY WENZEL, Univ of Pittsburgh, CHING-LONG LIN, Univ of Iowa — Severe asthmatics are characterized by alterations of bifurcation angle, hydraulic diameter, circularity of the airways, and local shift of air-volume functional change. The characteristics altered against healthy human subjects can affect flow structure and particle deposition. A large-eddy-simulation (LES) model for transitional and turbulent flows is utilized to study flow characteristics and particle deposition with representative healthy and severe asthmatic lungs. For the subject-specific boundary condition, local air-volume changes are derived with two computed tomography images at inspiration and expiration. Particle transport simulations are performed on LES-predicted flow fields. In severe asthmatics, the elevated air-volume changes of apical lung regions affect the increased particle distribution toward upper lobes, especially for small particles. The constricted airways are significantly correlated with high wall shear stress, leading to the increased pressure drop and particle deposition. The structural alterations of bifurcation angle, circularity and hydraulic diameter in severe asthmatics are associated with the increase of particle deposition, wall shear stress and wall thickness.

[1]NIH grants: U01-HL114494, R01-HL094315 and S10-RR022421. Computer time: XSEDE.

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Date submitted: 28 Jul 2014 Electronic form version 1.4