Abstract Submitted
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3D Model of Surfactant Replacement Therapy.[1] JAMES GROTBERG, CHENG-FENG TAI, University of Michigan, MARCEL FILOCHE, Ecole Polytechnique — Surfactant Replacement Therapy (SRT) involves instillation of a liquid-surfactant mixture directly into the lung airway tree. Though successful in neonatal applications, its use in adults had early success followed by failure. We present the first mathematical model of 3D SRT where a liquid plug propagates through the tree from forced inspiration. In two separate modeling steps, the plug first deposits a coating film on the airway wall which subtracts from its volume, a "coating cost". Then the plug splits unevenly at the airway bifurcation due to gravity. The steps are repeated until a plug ruptures or reaches the tree endpoint alveoli/acinus. The model generates 3D images of the resulting acinar distribution and calculates two global indexes, efficiency and homogeneity. Simulating published literature, the earlier successful adult SRT studies show comparatively good index values, while the later failed studies do not. Those unsuccessful studies used smaller dose volumes with higher concentration mixtures, apparently assuming a well mixed compartment. The model shows that adult lungs are not well mixed in SRT due to the coating cost and gravity effects. Returning to the higher dose volume protocols could save many thousands of lives annually in the US.

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