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Dynamics of Surfactant Liquid Plugs at Bifurcating Lung Airway Models HOSSEIN TAVANA, University of Akron — A surfactant liquid plug forms in the trachea during surfactant replacement therapy (SRT) of premature babies. Under air pressure, the plug propagates downstream and continuously divides into smaller daughter plugs at continuously branching lung airways. Propagating plugs deposit a thin film on airway walls to reduce surface tension and facilitate breathing. The effectiveness of SRT greatly depends on the final distribution of instilled surfactant within airways. To understand this process, we investigate dynamics of splitting of surfactant plugs in engineered bifurcating airway models. A liquid plug is instilled in the parent tube to propagate and split at the bifurcation. A split ratio, R, is defined as the ratio of daughter plug lengths in the top and bottom daughter airway tubes and studied as a function of the 3D orientation of airways and different flow conditions. For a given Capillary number (Ca), orienting airways farther away from a horizontal position reduced R due to the flow of a larger volume into the gravitationally favored daughter airway. At each orientation, R increased with $0.0005 < Ca < 0.05$. This effect diminished by decrease in airways diameter. This approach will help elucidate surfactant distribution in airways and develop effective SRT strategies.

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