Abstract Submitted
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Respiratory Fluid Mechanics JAMES GROTBERG, University of Michigan — This brief overview of our groups activities includes liquid plug propagation in single and bifurcating tubes, a subject which pertains to surfactant delivery, liquid ventilation, pulmonary edema, and drowning. As the plug propagates, a variety of flow patterns may emerge depending on the parameters. It splits unevenly at airway bifurcations and can rupture, which reopens the airway to gas flow. Both propagation and rupture may damage the underlying airway wall cells. Another topic is surfactant dynamics and flow in a model of an oscillating alveolus. The analysis shows a nontrivial cycle-averaged surfactant concentration gradient along the interface that generates steady streaming. The steady streaming patterns particularly depend on the ratio of inspiration to expiration time periods and the sorption parameter. Vortices, single and multiple, may be achieved, as well as a saddle point configuration. Potential applications are pulmonary drug administration, cell-cell signaling pathways, and gene therapy. Finally, capillary instabilities which cause airway closure, and strategies for stabilization, will be presented. This involves the core-annular flow of a liquid-lined tube, where the core (air) is forced to oscillate axially. The stabilization mechanism is similar to that of a reversing butter knife, where the core shear wipes the growing liquid bulge, from the Rayleigh instability, back on to the tube wall during the main tidal volume stroke, but allows it to grow back as the stroke and shear turn around.

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