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**Stability analysis of the pulmonary liquid bilayer.** DAVID HALPERN, University of Alabama, JAMES GROTBERG, University of Michigan — The lung consists of liquid-lined compliant airways that convey air to and from the alveoli where gas exchange takes place. Because the airways are coated with a bilayer consisting of a mucus layer on top of a periciliary fluid layer, a surface tension instability can generate flows within the bilayer and induce the formation of liquid plugs that block the passage of air. This is a problem for example with premature neonates whose lungs do not produce sufficient quantities of surfactant and suffer from respiratory distress syndrome. To study this instability a system of coupled nonlinear evolution equations are derived using lubrication theory for the thicknesses of the two liquid layers which are assumed to be Newtonian. A normal mode analysis is used to investigate the initial growth of the disturbances, and reveals how the grow rate is affected by the ratio of viscosities $\lambda$, film thicknesses $\eta$ and surface tensions $\Delta$ of the two layers which can change by disease. Numerical solutions of the evolution equations show that there is a critical bilayer thickness $\varepsilon_c$ above which closure occurs, and that a more viscous and thicker layer compared to the periciliary layer closes more slowly. However, $\varepsilon_c$is weakly dependent on $\lambda$, $\eta$ and $\Delta$. We also examine the potential impact of wall shear stress and normal stress on cell damage. This work is funded by NIH HL85156.

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