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Two layer fluid stress analysis during airway closure CHENG-FENG TAI, University of Michigan, DAVID HALPERN, University of Alabama, JAMES GROTBERG, University of Michigan — The airways are lined with a film consisting of two immiscible liquids, a serous layer and a more viscous mucus layer. Due to a surface tension driven instability, a liquid plug can form that obstructs the passage of air along the airways provided the ratio of the film thickness to the tube radius is greater than a critical value $\sim$0.12. In this study, we assume that the liquid layers are Newtonian, the surface tension is constant at the interfaces and the air-core phase is passive. We solve the Navier-Stokes and continuity equations subject to interfacial stress conditions and kinematic boundary conditions numerically using a finite volume approach in conjunction with a sharp interface method for the interfaces. Surface tension, viscosity and film thickness ratios can be altered by disease, and their influence on the closure instability is investigated. Results show that the shear and normal stresses along the airway walls can be strong enough to injure airway epithelial cells. We acknowledge support from the National Institutes of Health grant number NIH HL85156.

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