Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Effects of surfactant on propagation and rupture of a liquid plug in a tube NASUH YILDIRAN, Koc University, HIDEKI FUJIOKA, Tulane University, JAMES GROTBERG, The University of Michigan, METIN MURADOGLU, Koc University — Surfactant-laden liquid plug propagation and rupture occurring in lower lung airways are studied computationally using a front-tracking method. The plug is driven by an applied constant pressure in a rigid axisymmetric tube whose inner surface is coated by a thin liquid film. The evolution equations of the interfacial and bulk surfactant concentrations coupled with the incompressible Navier-Stokes equations are solved in the front-tracking framework. Available experimental data for surfactant Survanta are used to relate surface tension coefficient to surfactant concentration at the interface. The numerical method is first validated for a surfactant-free case and the results are found to be in good agreement with the earlier simulations of Fujioka et al. (2008) and Hassan et al. (2011). Then extensive simulations are performed to investigate the effects of surfactant on the mechanical stresses that could be injurious to epithelial cells such as pressure and shear stress and their gradients. It is found that the mechanical stresses are significantly reduced with the introduction of surfactants. Simulations are also performed to examine the effects of viscoelasticity contained in the liquid plug and some preliminary results are presented.

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Date submitted: 31 Jul 2017 Electronic form version 1.4