Abstract Submitted
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Effect of viscoelasticity and surfactant on an airway closure model[1] FRANCESCO ROMANO', University of Michigan & ENSAM - ParisTech, HIDEKI FUJIOKA, Tulane University, METIN MURADOGLU, Koc University, JAMES B. GROTBERG, University of Michigan — A liquid made out of mucus and serous layers lines the human lung airways. Several different flow regimes are observed depending on the generation of the bifurcation and when small airways are considered (9th or 10th generation of the airway tree), surface tension effects dominate and they can induce a Plateau-Rayleigh instability. The airway is modeled as a rigid pipe coated with a single-layer fluid and the effects of surfactant and non-Newtonian properties of mucus are investigated using numerical simulations. The viscoelasticity of mucus is taken into account by means of the Oldroyd-B model, whereas surfactant is considered for a Newtonian lining liquid. The evolution equations of the interfacial and bulk surfactant concentrations are solved coupled with the incompressible Navier–Stokes equations. The viscoelastic behavior of mucus strongly increases post-coalescence wall shear stresses (about 50% in their peak value) when the Laplace number is high, whereas pre-coalescence stresses are almost insensitive to the Weissenberg number. Surfactant has a negligible effect on the closure-induced shear stress, except when the elasticity parameter or the surfactant concentration is high enough. Our parametric study covers both, healthy and pathological conditions.

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