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Effect of viscoelasticity and surfactant on the propagation and rupture of a liquid plug in an airway[1] METIN MURADOGLU, Koc University, FRANCESCO ROMANO', University of Michigan ENSAM - ParisTech, HIDEKI FUJIOKA, Tulane University, JAMES B. GROTBERG, University of Michigan — The propagation and rupture of a liquid plug in a distal airway are studied using numerical simulations. The simulations are carried out using a finite-difference/front-tracking method, previously validated for airway reopening with Newtonian fluids. The airway walls are considered rigid and the plug is driven by a pressure gradient enforced between the extrema of the pipe. The effect of interfacial and bulk surfactant is considered, together with the viscoelasticity of mucus, which is here taken into account using the FENE-P model. Our parametric study shows that the presence of surfactant can efficiently reduce the wall stresses along the airway wall, hence surfactant helps to reduce the damage on the epithelial cells distributed along the internal surface of an airway. Moreover, the effect of several viscoelastic parameters is considered, such as the Weissenberg number, the length of the polymer and the polymer-to-solvent viscosity ratio. Particular attention is paid to the distribution of extra stresses due to the non-Newtonian behavior of mucus since interesting elastic dynamics are triggered by the liquid plug rupture over the liquid-gas interface.

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