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Numerical Simulations of the Propagation of a Liquid Plug through a 2D Airway Bifurcation[1] BENJAMIN L. VAUGHAN, JR., JAMES B. GROTBERG, University of Michigan — Numerous medical therapies require the instillation of liquids plugs and their delivery throughout the pulmonary airways. This process and the effect on the resulting liquid distribution is controlled by a number of parameters, including airway orientation with respect to gravity, initial plug volume, liquid physical properties, and the imposed airflow rate which drives the plug from behind. The airflow rate defines an operative Capillary number, Ca, and the influence of gravity appears as an effective Bond number, Bo, whose magnitude varies with orientation. In this study, we develop a numerical method for solving the propagation of a liquid plug into a two-dimensional airway bifurcation consisting of a parent channel branching into two daughter channels. We measure the splitting ratio, RS, which is defined as the ratio of the liquid plug volumes between the daughter branches. RS increases with Ca and asymptotes to 1 as Ca goes to infinity, which corresponds to an equal split, while increasing Bo requires a higher value of Ca for an equal split. We also examine the normal and shear stresses on the bifurcation walls and observe that the stresses on the upper walls increase as Bo increases while the stresses on the lower walls decrease as Bo increases.

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