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A computational model of microbubble transport through a blood-filled vessel bifurcation ANDRES CALDERON, JOSEPH BULL, The University of Michigan — We are developing a novel gas embolotherapy technique to occlude blood vessels and starve tumors using gas bubbles that are produced by the acoustic vaporization of liquid perfluorocarbon droplets. The droplets are small enough to pass through the microcirculation, but the subsequent bubbles are large enough to lodge in vessels. The uniformity of tumor infarction depends on the transport the blood-borne bubbles before they stick. We examine the transport of a semi-infinite bubble through a single bifurcation in a liquid-filled two-dimensional channel. The flow is governed by the conservation of fluid mass and momentum equations. Reynolds numbers in the microcirculation are small, and we solve the governing equations using the boundary element method. The effect of gravity on bubble splitting is investigated and results are compared with our previous bench top experiments and to a quasi-steady one-dimensional analysis. The effects of daughter tube outlet pressures and bifurcation geometry are also considered. The findings suggest that slow moving bubbles will favor the upper branch of the bifurcation, but that increasing the bubble speed leads to more even splitting. It is also found that some bifurcation geometries and flow conditions result in severe thinning of the liquid film separating the bubble from the wall, suggesting the possibility bubble-wall contact. This work is supported by NSF grant BES-0301278 and NIH grant EB003541.

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