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Modeling the deformation of a migrating cell adhering to a rigid ligand-coated substrate in the presence of a shear flow KENG-HWEE CHIAM, TAN LEI LAI, RAYMOND QUEK, A*STAR IHPC — We have developed a computational model for the process in metastasis where tumor cells that have intravasated into the vasculature are carried by the circulation to a distant part of the body. Using a two-dimensional model of a cell as a homogeneous viscoelastic drop that is parametrized by its cytoplasmic viscosity and membrane surface tension, we have shown that the length of the cell membrane that is adhered to the substrate can be expressed in a very simple relation involving only the product of the inverse of the cell's capillary number and the distance that the cell has migrated. We have also shown that this relation may be exploited in determining a cell's cytoplasmic viscosity in terms of mechanical quantities such as adhered length and distance migrated. This may aid in the development of microfluidic devices that may one day serve as a diagnostic tool to screen for tumor cells that have a different stiffness from normal cells. Finally, we have also shown that, when the cell is sufficiently close to the rigid substrate, adhesive forces mediated by receptors on the cell and ligands on the substrate is negligible. We provide evidence for this by showing that the length of the cell membrane adhered to the substrate is independent of the density of adhesion receptors on the cell's membrane.

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