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Mechanical response of tumor cells flowing through a microfluidic capillary ZEINA S. KHAN, Texas Tech University, Department of Mechanical Engineering, NABIOLLAH KAMYABI, Texas Tech University, Department of Chemical Engineering, FAZLE HUSSAIN, Texas Tech University, Department of Mechanical Engineering, SIVA A. VANAPALLI, Texas Tech University, Department of Chemical Engineering — Circulating tumor cells, the primary cause of cancer metastasis, are transported throughout the body to distant organs by blood flow. Despite the importance of cell transport and deformability in the vasculature for cancer metastasis, quantitative understanding of the hydrodynamic interactions between the cells and the blood vessel walls is lacking. Using a model microfluidic capillary of rectangular cross-section with an on-chip manometer coupled with high speed video imaging, we quantitatively investigate the hydrodynamic behavior via the cell excess pressure drop. By characterizing our device with simple model systems including viscous drops and soft elastic particles, we find that the excess pressure drop shows no apparent dependence on elastic modulus or interfacial tension, but depends significantly on internal viscosity for moderate confinements and shear stresses within the physiological range of 1-10 Pa. This suggests that the metastatic potential of circulating cells can be characterized by the effective viscosity. We test this hypothesis with several tumor cell lines and find that the effective cell viscosity determined from excess pressure drop measurements can be used to differentiate highly from lowly invasive cells.

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