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2-D Model for Normal and Sickle Cell Blood Microcirculation
YONATAN TEKLEAB, WESLEY HARRIS, Massachusetts Institute of Technology
— Sickle cell disease (SCD) is a genetic disorder that alters the red blood cell (RBC) structure and function such that hemoglobin (Hb) cannot effectively bind and release oxygen. Previous computational models have been designed to study the microcirculation for insight into blood disorders such as SCD. Our novel 2-D computational model represents a fast, time efficient method developed to analyze flow dynamics, O_2 diffusion, and cell deformation in the microcirculation. The model uses a finite difference, Crank-Nicholson scheme to compute the flow and O_2 concentration, and the level set computational method to advect the RBC membrane on a staggered grid. Several sets of initial and boundary conditions were tested. Simulation data indicate a few parameters to be significant in the perturbation of the blood flow and O_2 concentration profiles. Specifically, the Hill coefficient, arterial O_2 partial pressure, O_2 partial pressure at 50% Hb saturation, and cell membrane stiffness are significant factors. Results were found to be consistent with those of Le Floch [2010] and Secomb [2006].

Yonatan Tekleab

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