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Red cell-resolved blood flow modeling in in vivo-like microvascular networks: predicting hemodynamic changes due to loss of red cell deformability[1] SAMAN EBRAHIMI, PROSENJIT BAGCHI, Rutgers University — Microvascular networks in human body are made of the smallest blood vessels, and responsible for gas and nutrient transport to tissues, and regulation of blood flow in individual organs. The architecture of a microvascular network is complex and characterized by bifurcating, merging and tortuous vessels. Blood in such small vessels behaves as a concentrated suspension primarily made of red blood cells (RBC) which are extremely deformable. We developed a 3D simulation technique to model flow of deformable RBCs in physiologically realistic microvascular networks that are comprised of multiple bifurcating and merging vessels. The model is versatile, and can consider networks irrespective of topological/geometrical complexities. It provides fully 3D and detailed information of hemodynamic quantities, such as RBC partitioning at bifurcations, cell-free layer, and wall shear stress. Many diseases, such as sickle cell disease, malaria and diabetes mellitus, are associated with a loss of RBC deformability. A detailed quantification of changes in microvascular hemodynamics under such conditions is lacking. Using the model, we provide the first-ever simulation results on the changes in network-scale blood flow under varying RBC deformability. The specific focus is on retinal microcirculation which is known to be adversely affected due to loss of RBC deformability.

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