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**Cross-stream distribution of red blood cells in sickle-cell disease** XIAO ZHANG, Department of Chemical and Biological Engineering, University of Wisconsin-Madison, WILBUR LAM, Wallace H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, MICHAEL GRAHAM, Department of Chemical and Biological Engineering, University of Wisconsin-Madison — Experiments revealed that in blood flow, red blood cells (RBCs) tend to migrate away from the vessel walls, leaving a cell-free layer near the walls, while leukocytes and platelets tend to marginate towards the vessel walls. This segregation behavior of different cellular components in blood flow can be driven by their differences in stiffness and shape. An alteration of this segregation behavior may explain endothelial dysfunction and pain crisis associated with sickle-cell disease (SCD). It is hypothesized that the sickle RBCs, which are considerably stiffer than the healthy RBCs, may marginate towards the vessel walls and exert repeated damage to the endothelial cells. Direct simulations are performed to study the flowing suspensions of deformable biconcave discoids and stiff sickles representing healthy and sickle cells, respectively. It is observed that the sickles exhibit a strong margination towards the walls. The biconcave discoids in flowing suspensions undergo a so-called tank-treading motion, while the sickles behave as rigid bodies and undergo a tumbling motion. The margination behavior and tumbling motion of the sickles may help substantiate the aforementioned hypothesis of the mechanism for the SCD complications and shed some light on the design of novel therapies.

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