490c Leukocyte Margination in Microfabricated Blood Vessels

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Previous in vivo and in vitro studies have demonstrated that leukocyte margination in post-capillary venules is influenced by the aggregation level and hematocrit of blood. Many studies have measured the flux of leukocytes near the endothelium under dynamic conditions, but little is known about how hematocrit and RBC aggregation affect leukocyte trajectories during margination. To address this question, we designed and microfabricated a network of microchannels cast in a transparent silicone polymer and coated with a solution of PEG to minimize blood cell adhesion to the silicone walls. The geometry simulated by these experiments was a capillary to post-capillary venule expansions (10-25 μm). Solutions of blood cells were suspended in one of the following: normal plasma (i.e. whole blood), hepes buffer (which allows little RBC aggregation) or 3% Dextran (to induce high levels of RBC aggregation). Experiments were performed with each sample solution at high velocity (2 mm/s) and low velocity (0.5 mm/s). Leukocytes in whole blood solutions marginated more quickly at low velocities (41.35 μm) compared to higher velocities (122.04 μm). Leukocytes marginating in hepes buffer solutions showed no dependence on velocity and leukocytes suspended in 3% Dextran marginated very infrequently. The results indicate the average distance required for a leukocyte to marginate depends on the aggregation level of the suspending medium and that normal human blood, with intermediate levels of RBC aggregation, has appropriate rheological properties to facilitate leukocyte margination.