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Dynamics of blood flow in a microfluidic ladder network JEEVAN MADDALA, JEVGENIA ZILBERMAN-RUDENKO , OWEN MCCARTY, Oregon Health and Science University — The dynamics of a complex mixture of cells and proteins, such as blood, in perturbed shear flow remains ill-defined. Microfluidics is a promising technology for improving the understanding of blood flow under complex conditions of shear; as found in stent implants and in tortuous blood vessels. We model the fluid dynamics of blood flow in a microfluidic ladder network with dimensions mimicking venules. Interaction of blood cells was modeled using multiagent framework, where cells of different diameters were treated as spheres. This model served as the basis for predicting transition regions, collision pathways, re-circulation zones and residence times of cells dependent on their diameters and device architecture. Based on these insights from the model, we were able to predict the clot formation configurations at various locations in the device. These predictions were supported by the experiments using whole blood. To facilitate platelet aggregation, the devices were coated with fibrillar collagen and tissue factor. Blood was perfused through the microfluidic device for 9 min at a physiologically relevant venous shear rate of 600 s^{-1}. Using fluorescent microscopy, we observed flow transitions near the channel intersections and at the areas of blood flow obstruction, which promoted larger thrombus formation. This study of integrating model predictions with experimental design, aids in defining the dynamics of blood flow in microvasculature and in development of novel biomedical devices.

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