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Design and validation of a microfluidic pillar device to study hemostasis under flow HARI HARA SUDHAN LAKSHMANAN, Oregon Health and Science University, ADITY PORE, Texas Tech University, RACHEL THOMPSON, Oregon Health Science University, University of Connecticut, JEEVAN MADDALA, West Virginia University, PATRICK JURNEY, JOSEPH SHATZEL, Oregon Health Science University, SIVA VANAPALLI, Texas Tech University, OWEN MCCARTY, Oregon Health Science University — Hemostasis is an active process between plasma and blood cells, resulting in thrombin generation, platelet activation and fibrin formation to generate a hemostatic plug that staunches blood loss following vessel injury. The events that support hemostasis (outside the blood vessel) versus thrombosis (inside the blood vessel) are distinct in part due to the rheology of blood flow that differentially distributes blood constituents inside and outside blood vessels. We created an in vitro 'bleeding chip' to study the spatial dynamics and cell biology of hemostasis under shear flow. The bleeding chip consists of two orthogonal channels, with series of 3 pillars spaced 10 microns apart at the intersection of the channels acts as a model of endothelial cell barrier function between the intravascular and extravascular space. The bleeding channel is coated with extracellular matrix proteins. We found that platelets aggregate at or behind the pillars as a function of shear rate. Activation of the coagulation cascade staunched blood flow in the bleeding channel while blocking platelet function or coagulation prevented formation of a hemostatic plug. Based on the percolation theory of fluid dynamics, we will discuss the impact of platelet interactions during hemostasis.

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