Section one: Platelets (Basic & Clinical)
Experimental models

A NEW MICROFLUIDIC POINT-OF-CARE TEST FOR MULTI-SHEAR PLATELET THROMBOSIS
D. N. Ku1, M. Li2, C. Forest1, K. Hefelfinger1, S. Gurnani1, O. Martinez1, N. Turturro1, P. Gandhi1
1Mechanical Engineering, 2BioMedical Engineering, GEORGIA INSTITUTE OF TECHNOLOGY, Atlanta, United States

Objectives: Arterial thrombosis causes stroke and heart attack by stimulating platelet adhesion through very high shear rate hemodynamics over a ruptured plaque with exposed subendothelial collagen. Currently, few platelet thrombosis tests provide these high-shear pathologic conditions, which may reveal the significant variability of patients’ responsiveness to anti-platelet treatments. We report on the development of a Point-of-Care platelet thrombosis test that uses a microfluidic chamber and optical system to measure thrombus growth.

Methods: A four-chamber test section is created in PDMS with anatomic geometries of a scaled stenotic artery producing shears of 1500, 4000, 7000, and 10,000 1/s. A total of 40 ml of whole blood flow is governed by a constant pressure head and distal resistance. Thrombosis growth on collagen is determined in real-time by transmission of a laser light that alternately interrogates each test section at 1Hz. The local shear rate within the growing thrombus is quantified using fluid modelling with ANSYS.

Results: The microfluidic system produced rapid platelet accumulation under very high shear conditions using human whole blood. At 1,500 s^-1 shear rate, no thrombosis was observed. At 10,000 s^-1, occlusive thrombosis occurred in the stenosis (8/11, 73%, p<0.05). Computational fluid mechanics modelling of the throat demonstrates an increase in shear rate of 376% during thrombus growth. The POC design has been adapted to a prototype bench top format 30”x16”x15” in size including fluidic handling and optics that takes 30 minutes per test.

Image/Graph:

Conclusion: The system enables real-time testing of human whole blood for shear induced platelet thrombosis at multiple shear flow conditions. The size and ease-of-use of the system allows for Point-of-Care measurements of high shear clotting potential from individual patient blood samples. Future work will adapt this system for simultaneous treatments by different anti-platelet agents at varying dosages.
Disclosure of Interest: None Declared

Keywords: Shear Platelets Thrombosis Point-of-Care Multi-shear anti-platelet variability