

Adhesion and Aggregation of Platelets

Work with Dr. Connie Hall at IIT (Chicago)

Lindsay Crowl

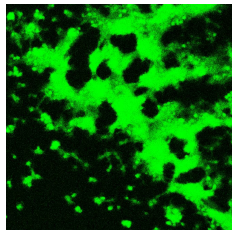
Summer Lab Work

September 5, 2007

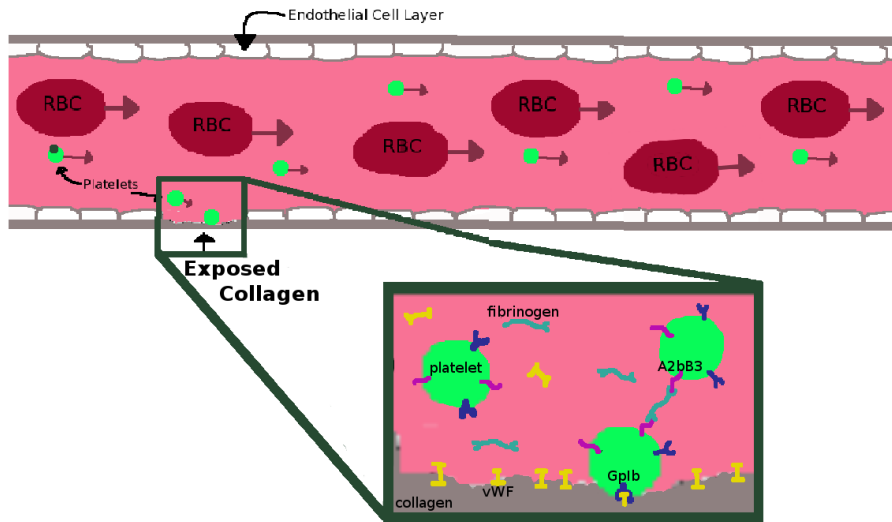


Biological Background

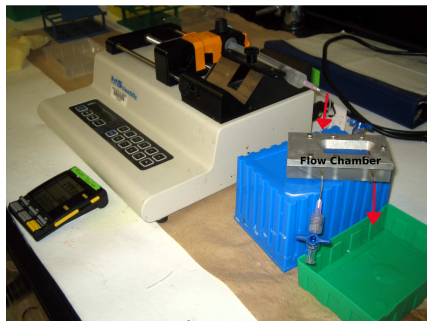
- Blood is composed of:
 - red blood cells
 - **platelets**
 - white blood cells
 - plasma
- Platelets repair damaged vessel walls by
 - adhering to injured vessel wall (collagen)
 - aggregating with other platelets to form a plug
- How do platelets stick?
 - receptor proteins $\alpha_{IIb}\beta_3$ and G_pI_b
 - von Willebrand factor and fibrinogen (in plasma)



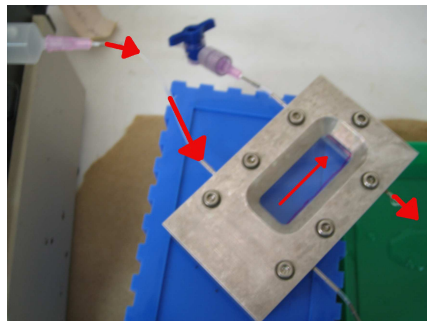
Platelet Adhesion/Aggregation (*in vivo*)



Experimental Setup



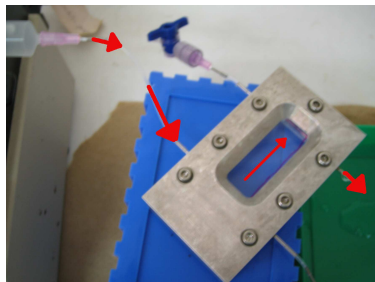
Flow chamber setup



Flow chamber closeup

Experimental Setup

- Collagen type I placed on glass slide
- Blood drawn from donor
 - Heparin added (anticoagulant)
 - Mepacrine added (fluoresces platelets)
- Calculate flow chamber dynamics (parabolic flow)
 - flow rate, Q
 - wall shear rate γ_w



Experimental Setup

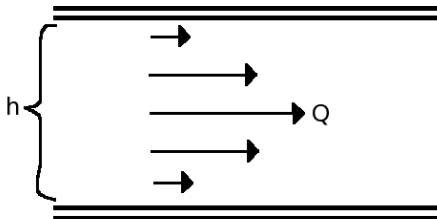
What do we want to study?

- Compare adhesion/aggregation on a surface over time
- Compare adhesion/aggregation for different shear rates

Why do we care about what happens at different shear rates?

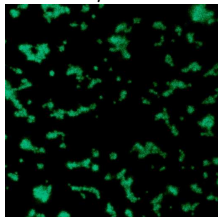
- Veins $\gamma_w < 500$ 1/sec
- Stenosed arteries $\gamma_w \approx 40,000$ 1/sec

$$\gamma_w = \alpha \frac{Q}{h}$$

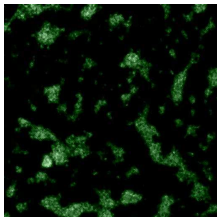


Platelet Adhesion/Aggregation: Time

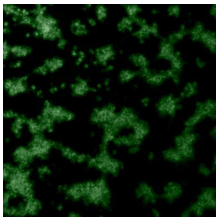
scale $143\mu\text{m}$



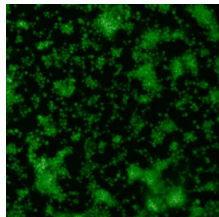
3 minutes;
 $Q=0.5$ mL/min;
 12% coverage;
 height = $10\mu\text{m}$



6 minutes;
 $Q=0.5$ mL/min;
 19% coverage;
 height = $11\mu\text{m}$



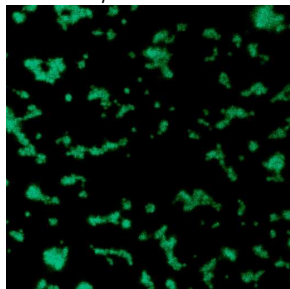
12 minutes;
 $Q=0.5$ mL/min;
 28% coverage;
 height = $8\mu\text{m}$



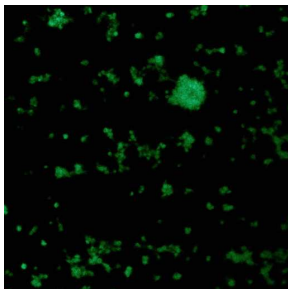
18 minutes;
 $Q=0.5$ mL/min;
 50% coverage;
 height = $21\mu\text{m}$

Platelet Adhesion/Aggregation: Flow Rate

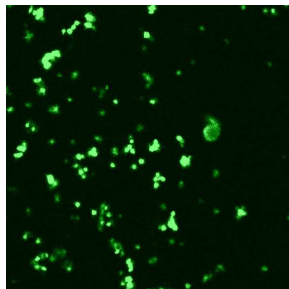
Scale $143\mu\text{m}$



3 minutes;
 $Q=0.5$ mL/min;
12% coverage;
height = $10\mu\text{m}$



3 minutes;
 $Q=2.0$ mL/min;
10% coverage;
height = $10\mu\text{m}$



3 minutes;
 $Q=6.0$ mL/min;
5% coverage;
height = $9\mu\text{m}$

Future Directions: what to do with biological data?

Main Focus:

Build a computational model involving platelet dynamics using immersed boundary-lattice Boltzmann method to simulate platelet aggregation.

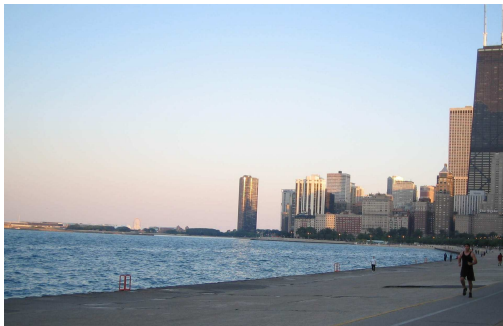
Current Focus:

Platelets take up 1% of blood, while RBCs take up 40%. Platelet excess near vessel walls is a well known phenomena.

Want to know how platelets diffuse toward vessel wall

→ computationally expensive to put both RBCs and platelets in IBM

Questions?



Thanks RTG!