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Validation of a Microfluidic-based Platelet Rolling Assay to Characterize von Willebrand Disease Phenotypes

Von Willebrand disease is the most common hereditary bleeding disorder. This disease is caused by mutations in the protein called Von Willebrand Factor. VWF links platelets to a damaged blood vessel wall in order to cease bleeding from that vessel. I used a microfluidic-based experiment to measure the VWF-platelet glycoprotein Ibα receptor interaction in the presence of physiological flow conditions. By studying VWD-causing mutations in the presence of shear stress, I obtained insight into the phenotypes of patients with these mutations. Samples of both the wild type VWF as well as the mutated R1374C VWF were harvested through transfection. The two proteins were then applied onto a glass slide. Then, purified platelets from normal, healthy donor blood were perfused over the glass slides. A video was recorded at different shear stresses for the mutant and the normal protein.

The analysis revealed the velocities of the platelets once they adhered to the slide. The velocities of the platelets that were observed on the slide with R1374C VWF moved along the slide more rapidly than did the platelets on the slides with the wild type protein. This affirms that the type 2M VWD mutation affects platelet binding kinetics. We showed that the microfluidic assay used was able to distinguish type 2M VWD mutant from wild-type VWF based on platelet rolling velocities on each surface at a variety of shear stresses. This validates the use of our microfluidic platelet rolling assay for the purpose of investigating the VWF platelet GPIbα interaction in cases of VWD.