Type: Invited lecture

Title: Imaging blood and endothelial cells and measuring their interaction forces with laser tweezers

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The flux of blood in a human body depends on many different factors, among which the microrheologic factors predominate. In particular, microrheologic factors directly related to the interaction of blood cells and the interaction between blood cells and endothelium monolayer. In most cases, blood cell interaction means either red blood cell (RBC) aggregation, platelets aggregation, or coagulation process [1]. RBC aggregation is a reversible process of linear or more complex structures production. RBC aggregation significantly alters blood viscosity, and the mechanisms of RBC aggregation as well as endothelial issues are still being studied. Endothelium monolayer is an isolating layer between liquid blood and other cells of the body. The interaction between endothelium and blood cells is of great importance. Both RBC and endothelium can be studied in vitro on single cell level using laser tweezers. Laser tweezers are a scientific tool using a highly focused laser beam to trap and manipulate dielectric microparticles, in particular, living cells [2]. RBC were extensively studied using laser tweezers, however, there is no full understanding of RBC behavior in the laser trap.

The main aims of this work were both to study the behavior of RBC in an optical trap and to study the interaction of RBCs of healthy donors with endothelial cells monolayer and to measure the interaction forces between RBCs and endothelium at single cell level using laser tweezers.

The laser power limitations for the optical trapping as well as the measurement time duration limits were found. The interaction forces between RBC and endothelium were measured for different concentrations (0-8 mg/ml) of the main RBC aggregation inducer as well as the main coagulation protein – fibrinogen. It was found that there is saturation of the interaction force in the range of fibrinogen concentration 4-8 mg/ml. These results are important for better understanding of RBC and endothelium interaction at single cell level.

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[1] Baskurt O., Neu B., and Meiselman H. “Red Blood Cell Aggregation”, CRC Press, Boca Raton, United States, 2012.

[2] Ashkin A. “Optical Trapping and Manipulation of Neutral Partials Using Lasers: a reprint volume with commentaries,” Mainland Press, Singapore, 2006.