Effect of deformability difference between two erythrocytes on their aggregation

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ABSTRACT

In this study, we investigated the rheology of a doublet that is an aggregate of two red blood cells (RBCs). According to previous studies, most aggregates in blood flow consist of RBC doublet-pairs and thus the understanding of doublet dynamics has scientific importance in describing its hemodynamics. The RBC aggregation tendency can be significantly affected by the cell’s deformability which can vary in both physiological and pathological conditions. Hence, we conducted the numerical simulation of doublet dynamics in a simple shear flow condition with different deformability between RBCs. To study the dissociation process of the doublet, we employed the aggregation model described by the Morse type potential function, which is based on the depletion theory. In addition, we developed a new method of updating fluid property to consider viscosity difference between RBC cytoplasm and plasma. Our results showed that deformability difference between the two RBCs could significantly reduce their aggregating tendency, resulting in disaggregation. Since even in physiological conditions, the cell deformability may be significantly different, consideration of the difference in deformability amongst RBCs in blood flow would be needed for the hemodynamic studies based on numerical approach.

Keywords: Hemodynamics, LBM, IBM, RBC doublet dissociation