Mural Thrombosis in a Two-Level Computational Approach; Combination of Continuum and Particle-Based Methods

***S. Muhammad R. Hassani*[a], *Nasser Fatouraee* [a,1]**

[a] *Biological Fluid Mechanics Research Laboratory, Department of Biomedical Engineering, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran 15914*

Mural thrombosis onset and growth has been the center of attention of many researchers and have been modeled by several methods and in different resolutions due to the pathological and clinical importance of the phenomenon. Blood, as a complex fluid, incorporates many components which influence the process of platelet aggregation in different scales; Chemical activation of coagulant factors in microscale, cells suspension in mesoscale and plasma flow in macroscale. To model the process, this proper approach is to consider as many characteristics of the process as possible. In our work, we implemented the Dissipative Particle Dynamics (DPD) method to simulate plasma flow and platelet suspension (as relatively frozen DPs) in a 2D channel. Beside this, the transport of coagulant factor and their activation (both platelet-secreted and platelet-synthesized) are modeled by a set of interconnected convection-diffusion-reaction (CDR) equations. The two methods are coupled in two way; the solution of CDR equations are used to determine that the platelets whether are activated or not and the DPD solution of position of activated platelets as the source of activating factors and the velocity field are fed to the CDR equations. The results have shown that number of deposited-platelet growth factor as well as distribution of the coagulant factors are in a good agreement with the prior computational and the *in-vitro* studies. In conclusion, the proposed approach, in comparison with prior works, provides a deeper view on the phenomenon since it illuminates the colloidal characteristic of the flow and eliminates the uncertainty involved with the distance-dependent activation models.

Keywords:
Mural Thrombosis, Dissipative Particle Dynamics, Convective-Diffusion-Reaction Equations, Microscale, Mesoscal, Macroscale.

1 Corresponding Author: Nasser Fatouraee ; nasser@aut.ac.ir ; Tel: (+98-21) 64542368