Recent Progress in the Mathematical Modeling of Blood Coagulation

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Abstract

Blood coagulation is an extremely complex biological process in which blood forms clots (thrombus) to prevent bleeding; it is followed by their dissolution and the subsequent repair of the injured tissue. The process involves different interactions between the plasma, the vessel wall and platelets with a huge impact of the flowing blood on the thrombus growth regularization.

A new mathematical model and some numerical results for thrombus development will be presented in this talk. The cascade of biochemical reactions interacting with the platelets, resulting in a fibrin-platelets clot production and the additional blood flow influence on thrombus development will be discussed.

Two main aspects will be considered. The first one is the mathematical model reduction in terms of biochemical reactions to simplify the model complexity, allowing results in agreement with experimental data. A virtual equation to maintain the reliable prothrombinase production and additional platelets impact to the blood clot evolution is also included. The second feature of the model is to impose the slip velocity and the consequent supply of activated platelets in the clot region, showing its importance on the whole blood coagulation process [**?**].

The model consists of a system of 13 nonlinear convection-reaction-diffusion equations, describing the cascade of biochemical reactions, coupled with a shear-thinning viscosity model for blood flow. The main objective of this study is to build a blood coagulation model able to predict effects of specific perturbations in the hemostatic system that can't be obtained by laboratory tests, and assist in clinical diagnosis and therapies of blood coagulation diseases.

References

[1] Fasano A., Pavlova J., Sequeira A. "A synthetic model for blood coagulation including blood slip at vessel wall" Clinical Hemorheology and Microcirculation, **51**, 1–14 (2012).