FIBRIN POLYMERIZATION IN BLOOD COAGULATION REACTIONS. THEORETICAL ANALYSIS

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Fibrin polymerization is a process that completes the blood coagulation cascade. Fibrin polymer forms clots. The approaches to mathematical description of blood coagulation developed up to now generally restricted by the reactions of thrombin generation. Thrombin is a key factor of blood coagulation cascade that transforms fibrinogen molecules to fibrin-monomer.

The kinetics of thrombin generation depends upon a set of blood coagulation factors. Its change in time is usually described by complicated nonlinear mathematical models.

In this work we made an attempt to expand thrombin generation model by the equations of fibrin polymerization. Fibrin polymerization is described by Smoluchowski equations, in correspondence with the polymerization theory [1]. Thus our model takes into account generation of fibrin-monomers, their polymerization, polymer fragmentation and degradation.

The change of aggregate state of blood is a result of formation of fibrin gel. It is assumed that sol-gel transition is related to divergence of the second moment of polymers distribution [2]. Analysis of the mathematical model developed demonstrates that kinetics of fibrin gelation has typical features of blow-up regimes [3].

It was shown that the velocity of thrombi formation is controlled by reactions of thrombin generation as well as by fibrin polymerization reactions. Particularly, under definite conditions formation of fibrin gel may take place even when thrombin concentration is below the threshold. If the disturbances of polymerization reactions take place, an opposite situation may occur: explosive thrombin generation in this case is not accompanied by fibrin gel formation.

Literature

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