P134 COMPUTATIONAL ANALYSIS OF PLATELET AGGREGATION IN A TAYLOR-COUETTE SYSTEM

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Objectives: The support of functions of the human body by means of blood-contacting artificial organs often leads to complications. One of the major threats is the formation of thrombi, which can be fatal to patients in case of thromboembolic incidents or device obstruction. Aim of this study is to computationally simulate blood flow under the influence of well-defined shear rates for laminar flow and laminar flow with superposed secondary flow.
The simulation is compared to experimental evaluations and shall serve as a basis for the development of a mathematical model of flow-related mechanisms and their influence on the behavior of platelet activation and aggregation which occur in artificial organs or systemic bifurcations.

Methods: Three-dimensional flow of blood between two rotating co-axial cylinders was investigated. The Taylor-Couette system allows the examination of plain laminar flow as well as stable Taylor vortex flow. The numerical analysis was performed with the flow solver XNS. A mesh of 800,000 hexahedral elements was used to model a region spanning two Taylor vortices. The mathematical model is designed to include the transport of platelets and of platelet activating substances by convective and diffusive mechanisms.
Results: The visualization of the simulation data shows the complex interplay between laminar flow, recirculation and stagnation regions, which are all experimentally observed aspects of the Taylor vortex flow.
As an aid to experimental design it was possible to vary the Taylor-number in the computations in small steps in order to define the next relevant experimental conditions. By analysis of the computational visualization it is possible to define the flow conditions and regions that lead to increased platelet aggregation.

Conclusion: The simulation results are helpful in explaining the different adhesion and aggregation behavior for the examined flow conditions and serve as a basis for solving the mathematical aggregation model.