Numerical modeling of compensation mechanisms for peripheral arterial stenoses

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ABSTRACT

In this talk, we present a numerical model for physiological mechanisms that help to compensate reduced blood flow caused by a peripheral arterial stenosis. Thereby we restrict ourselves to the following compensation mechanisms: Metabolic auto-regulation and arteriogenesis. Our model is based on dimensionally reduced differential equations to simulate large time periods with low computational effort. For the numerical discretization of the partial differential equations governing the blood flow, we use the method of characteristics due to its stability properties. As a test scenario, we consider a stenosis located in the right posterior tibial artery of a human. We study its impact on blood supply for different narrowing degrees by the help of numerical simulations. Moreover, the efficiency of the above compensation mechanisms is examined. Our results reveal that even a complete occlusion can be compensated, if metabolic auto-regulation is combined with at least 5 collateral arteries, whose diameters are magnified by a factor 2.38 during arteriogenesis.

References

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