Numerical modeling of autoregulation in human common carotid artery

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Introduction: Cardiovascular system has its own metabolic and functional requirements and needs a variable amount of blood flow; hence, autoregulation is an important phenomenon for this organ. Shear stress induced autoregulation is defined as the innate ability of an organ to keep its hemodynamic conditions stable against changes in heart rate and blood perfusion pressure. For example, when heart rate changes, arterial vessels undergo vasodilation or vasoconstriction in order to stabilize the hemodynamic forces and stresses with respect to the flow needed.

Materials and Methods: The current study examines the local mechanisms employed in automatic control. Local regulatory mechanisms function independently of external control mechanisms, such as sympathetic nerves and endocrine hormones. Therefore, they can be considered isolated mechanisms. The application of boundary conditions in numerical modeling is of utmost importance, hence, using arterial tree modeling to achieve appropriate boundary conditions seems necessary.

Results: We have presented an extensive lumped parameter model as the first step in our study. Then, we used this model to obtain inflow, outflow, and blood pressure boundary conditions for the common carotid artery. As one of the most important hemodynamic parameters, shear stress regulation then modeled in an axisymmetric model of CCA.

References:

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