Modeling of peristaltic flow of the pathological bile as Carreau's fluid in the biliary system elements

A. Kuchumov, Y. Nyashin, V. Samartsev
Perm National Research Polytechnic University, Russia
kychymov@inbox.ru

Biliary system is responsible for bile transport to the duodenum. The system includes the gallbladder, biliary tree, and sphincter system. It is known, that physiological motion of many bio-fluids is related to wavy contraction of hollow organ walls peristalsis. Early, authors showed that pathological bile is non-Newtonian thixotropic fluid and obtained parameters of the Carreau's fluid. The presented paper contains results of peristaltic fluid modeling of the pathological bile considered as the Carreau's fluid in the biliary system elements (the cystic duct, the common bile duct, and ampoule of the Oddi's sphincter with a calculus) modelled as tubes with different geometry and permeable walls to study the conditions of reflux occurring. The analytical solutions for stream function, axial velocity, and flux at small Weissenberg numbers were obtained by using of the perturbation method. The permeability parameter influence on the computational results is shown. The dependences of pressure drop on flux, time and amplitude ratio for sinusoidal wave are also presented. The values of pressures corresponding to reflux occurrence are obtained. The reported study was supported by RFBR, research project No. 14-01-31027-mol_a.

Modelling of the TCPC geometry effects on hemodynamics of the cardiovascular system with one functionally ventricle

F. Maršík, S. Převorovská
Academy of Sciences of the Czech Republic, Prague, Czech Republic
marsik@it.cas.cz

The numerical simulation of the total cavopulmonary connection (TCPC) geometry on the univentricular circulation offers the possibility to restore almost physiological hemodynamics conditions. The TCPC consists in a direct connection between the superior vena cava and pulmonary arteries along with the conduit connecting the inferior vena cava to these arteries. The lumped-parameter model of the single ventricle circulation has been developed with view of the modelling of the TCPC geometry influences on the cardiovascular hemodynamics and energy losses. This model represents the circulatory system as a hydraulic network encompassing a resistance, compliance and inertance elements. The mathematical formulation of the blood flow through this network is based on the laws of mass and momentum conservation and mechanical energy balance. Especial attention is devoted to prevent hydrodynamic instabilities (e.g., gas release from blood-cavitation) in the specified hemodynamics regions. The results attained by the numerical simulation show that supervised effects play a crucial role in the regulation of the pulmonary and systemic blood flow