A Study on Multiscale Model in the presence of Systemic-to-Pulmonary Shunt utilizing LBM-LPM

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In this study, a 0-dimension (0D) and 3-dimension (3D) coupled model for the circulatory system in the presence of systemic-to-pulmonary artery shunt in patient with univentricular heart was constructed. In the multiscale model, the artery-shunt was represented by a 3D cylinder, which was connected to peripheral 0D network that represents the patient's morbid circulation. Multiscale coupling process based on time-step was worked out by writing the code of 0D model solver into the open-source CFD software Palabos which is based on Lattice Boltzmann (LB) Method and was considered to be with potential benefits for simulating local hemodynamic and highly paralleled. Results of global hemodynamic changes due to the surgery and local 3D fluid patterns were given, which showed that blood distribution of pulmonary circulation was improved. Multiscale simulation is concluded as a method which could consider the interaction of local change and global circulation, which makes the boundary-condition of 3D simulation better reproduced. Besides, LB Method shows its benefits on multiscale computation.

Keywords: Multiscale Model, Lattice Boltzmann Method (LBM), Computational Fluid Dynamics (CFD), Hemodynamics