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Pulsatile Flow and Gas Transport of Blood over an Array of Cylinders KIT YAN CHAN, JAMES B. GROTBERG, University of Michigan — In the artificial lung, blood passes through an array of micro-fibers and the gas transfer is strongly dependent on the flow field. The blood flow is unsteady and pulsatile. We have numerically simulated pulsatile flow and gas transfer of blood (modeled as a Casson fluid) over arrays of cylindrical micro-fibers. Oxygen and carbon dioxide are assumed to be in local equilibrium with hemoglobin in blood; and the carbon dioxide facilitated oxygen transport is incorporated into the model by allowing the coupling of carbon dioxide partial pressure and oxygen saturation. The pulsatile flow inputs considered are the sinusoidal and the cardiac waveforms. The squared and staggered arrays of arrangement of the cylinders are considered in this study. Gas transport can be enhanced by: increasing the oscillation frequency; increasing the Reynolds number; increasing the oscillation amplitude; decreasing the void fraction; the use of the cardiac pulsatile input. The overall gas transport is greatly enhanced by the presence of hemoglobin in blood even though the non-Newtonian effect of blood tends to decrease the size and strength of vortices. The pressure drop is also presented as it is an important design parameter confronting the heart.

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