Some collective phenomena in blood flow

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Abstract

Red blood cells (RBCs) dictate Blood flow properties, in healthy conditions. Several questions regarding novel and intricate collective phenomena will be described. It will be shown that blood flow elements, if hematocrit is not too large, organize in ordered patterns with several impacts on rheology. Simulation results together with experimental observations will be reported. For example, spatial organization significantly lower the effective viscosity, and limits the increase of the viscosity with hematocrit in microcirculation, ensuring a proper regulation of oxygen transport even when hematocrit is sensibly beyond the normally admitted value. For example, athletics adopting blood doping as well as in some diseases (like primary and secondary polycythemia) an increase in hematocrit normally causes blood to become more viscous in macrocirculation. However, in microcirculation, depletion of RBCs close to the vessel walls, as well as spatial organization significantly moderate the increase of viscosity with hematocrit. It will be shown, however, that there is a critical hematocrit beyond which blood flow efficiency undergoes a collapse signaling severe deterioration of oxygen supply to tissues and organs. This is the case with the polycythemia vera disease.