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On the relation between red blood cell flexibility and the oxygenation-deoxygenation process MEHDI NIAZI ARDEKANI, AMIR SAADAT, Department of Chemical Engineering, Stanford University, JIANDI WAN, Department of Chemical Engineering, University of California Davis, JUAN SANTIAGO, Department of Mechanical Engineering, Stanford University, ERIC SHAQFEH, Department of Chemical Engineering, Stanford University — A host of diseases directly influence the mechanical and chemical properties of the bloods main cellular component, red blood cells (RBCs). Among these, Chronic Fatigue Syndrome, Sepsis, and COVID19 are examples. The symptoms including fatigue, orthostatic intolerance and cognitive disturbances suggest poor tissue oxygenation even with normal hemoglobin concentration. On the other hand, it has been shown very recently that local oxygen pressure can change and control RBC deformability and, in turn, capillary cell velocity. We recently developed a microfluidic device and analysis platform to accurately measure, for the first time, the intrinsic flexibility of many RBCs. We will present extensions of this platform toward the problem of studying the effects of oxygen concentration levels on RBC deformability. This will include a new numerical model for oxygen transport developed and added to our existing RBC simulation methods. This method is based on an immersed finite element method (for the cell mechanics) and a finite-volume incompressible flow solver, that allows for simulation of RBC flows where the membrane shear modulus varies with the oxygen concentration inside the cell. Our goal is to demonstrate the relation between poor tissue oxygenation and RBC cell elasticity.

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