

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Patient-specific modeling and analysis of dynamic behavior of individual sickle red blood cells under hypoxic conditions¹ XUEJIN LI, Brown University, E. DU, Florida Atlantic University, ZHEN LI, YU-HANG TANG, LU LU, Brown University, MING DAO, Massachusetts Institute of Technology, GEORGE KARNIADAKIS, Brown University — Sickle cell anemia is an inherited blood disorder exhibiting heterogeneous morphology and abnormal dynamics under hypoxic conditions. We developed a *time-dependent* cell model that is able to simulate the dynamic processes of repeated sickling and unsickling of red blood cells (RBCs) under physiological conditions. By using the kinetic cell model with parameters derived from *patient-specific* data, we present a mesoscopic computational study of the dynamic behavior of individual sickle RBCs flowing in a microfluidic channel with multiple microgates. We investigate how individual sickle RBCs behave differently from healthy ones in channel flow, and analyze the alteration of cellular behavior and response to single-cell capillary obstruction induced by cell rheologic rigidification and morphological change due to cell sickling under hypoxic conditions. We also simulate the flow dynamics of sickle RBCs treated with hydroxyurea (HU) and quantify the relative enhancement of hemodynamic performance of HU.

¹This work was supported by the National Institutes of Health (NIH) Grant U01HL114476.

Xuejin Li
Brown University

Date submitted: 30 Jul 2015

Electronic form version 1.4