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Microfluidic investigation of the effects of oxidative stress on mechanotransduction in red blood cells N.F. ZENG, W.D. RISTENPART, University of California at Davis — Recent work has suggested that RBCs are able to sense and respond to small changes in their environment through post translational modifications (PTMs) in membrane proteins. Because oxidative stress is an important driving force to induce PTMs, the effects of oxidative stress on membrane deformability, lipid peroxidation, and cytoskeletal/hemoglobin crosslinking have been studied extensively. However, experimental work to date on the effects of oxidative stress on RBC mechanotransduction has been limited to applied forces dissimilar to those experienced by RBCs in vivo. Here we investigate the dynamics of shear-induced mechanotransduction in RBCs subjected to varying degrees of oxidative stress by using hydrogen peroxide as a generator of oxidizing radicals. We use a microfluidic platform to impose precisely defined fluid flows that mimic in vivo conditions. The RBCs are visualized passing through a narrow constriction using high speed video at 15,000 frames per second, and quantitative hematological information including cell elongation, rotation and velocity are extracted via custom image analysis algorithms. We demonstrate that oxidative stress significantly alters the dynamic behavior of the RBCs under flow conditions, and we discuss the implications for the consequent effects on mechanotransductive vasodilatory signaling.

William Ristenpart

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