

REGULATION OF BLOOD FLOW IN THE MICROCIRCULATION: ROLE OF RED BLOOD CELLS AS OXYGEN SENSORS. Julia C. Arciero¹ and Timothy W. Secomb^{1,2} ¹Program in Applied Mathematics, ²Department of Physiology, University of Arizona, Tucson AZ 85721

The most critical role of the circulatory system is to adequately supply tissues with oxygen. The amount of oxygen required by a tissue varies according to the tissue's local metabolic activity, growth, and response to external stimuli. As oxygen consumption increases within tissue, blood oxygen levels drop, triggering blood vessels to dilate. This vasodilation causes an increase in vessel diameter, thereby leading to increased flow through the vessel. The mechanism of this response is not well understood. Several studies suggest that red blood cells act not only as oxygen carriers but also as oxygen sensors. After passing through capillaries, red blood cells that have been depleted of oxygen release adenosine triphosphate (ATP). This ATP triggers an electrical signal that is conducted upstream along blood vessel walls, causing supplying arterioles to dilate. We are developing a model to predict the concentration of ATP and oxygen downstream of capillaries by considering ATP release within vessels and oxygen consumption in tissue. We begin by modeling ATP release along a single vessel. We show that the amount of ATP release that our model predicts is consistent with that obtained in experimental studies. In the future, we will develop a theoretical model that considers the contributions of conducted responses and responses to intravascular pressure, and wall shear stress to blood flow regulation in vascular networks.