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The Red Blood Cell as a Source for Oxidative Stress in vivo

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Abstract

The primary purpose of the Red Blood Cell (RBC) is to transport Oxygen from the lungs to the tissues. However, hemoglobin also undergoes a continuous slow autoxidation reaction whereby the Fe(II) heme is oxidized to Fe(III) heme and the bound oxygen is reduced to superoxide, which initiates an oxidative cascade reaction involving the production of various reactive oxygen species (ROS). This process is dramatically enhanced for partially oxygenated hemoglobin present in the microcirculation where oxygen is being transferred to the tissues. Although this reaction involves only a small fraction of the hemoglobin, considering the large pool of RBCs, it is a source of ROS that cannot be neglected. The actual transfer of ROS from the RBC to lung capillary venules under hypoxic conditions and the resultant inflammatory response has been demonstrated by rat and mice studies. In order to evaluate potential pathophysiological affects of RBC oxidative stress we have developed a method to evaluate the extent of RBC oxidative stress. During the autoxidation reaction, a fraction of the non-neutralized ROS attacks the heme producing fluorescent heme degradation products. These products are found in all blood samples and reflect an integrated measure of RBC oxidative stress. We have shown that certain diseases like sickle cell disease are associated with an increase in RBC oxidative stress. These studies indicate that oxidative stress originating from the RBC contributes to the pathology associated with certain diseases.

Biography

Joseph M Rifkind completed his Ph.D in physical chemistry from Columbia University in 1966. He has been at the National Institutes of Health since 1968. Since 1985 he was the Chief of the Molecular Dynamics Section at the National Institute on Aging. He has published over 130 papers in peer reviewed journals and over 20 book chapters. His research has been directed at the physiological role of oxidative stress and nitric oxide metabolism primarily involving the red blood cell with 8 papers dealing with amyloids and Alzheimer's disease.

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