Altitude Hypoxia Increases Glucose Uptake in Human Heart

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Abstract

Abstract Chen, Chi-Hsien, Yuh-Feng Liu, Shin-Da Lee, Wen-Chih Lee, Ying-Lan Tsai, Chien-Wen Hou, Chih-Yang Huang, and Chia-Hua Kuo. Altitude hypoxia increases glucose uptake in human heart. High Alt. Med Biol. 10:83-86, 2009.-Cardiac muscle is a highly oxygenated tissue that produces ATP mainly from fat oxidation. However, when the rate of oxygen demand exceeds oxygen supply, energy reliance on the carbohydrate substrate becomes crucial for sustaining normal cardiac function. In this study, the effect of acute altitude hypoxia on glucose uptake from circulation was determined, for the first time, in the human heart, using [18F]-2-deoxy-2-fluoro-D-glucose positron emission tomography (FDG-PET) in a simulated altitude condition (14% O(2), corresponding to approximately 3000 m above sea level) or room air (21% O(2)). Our results showed that subjects (n = 6) started to experience difficulty in sustaining the hypoxic condition at approximately 45 min. This was concurrent with a substantially increased blood lactate concentration, which reflects an accelerated rate of anaerobic glycolysis. Hypoxia elevated FDG uptake above control by approximately 70% in heart, but not in limbs (representing primarily skeletal muscle), brain, and liver. This study provides the first human evidence for the hypoxia-stimulated glucose uptake in heart. At this hypoxia level, the previously observed hypoxia-stimulated glucose uptake in rat skeletal muscle was not confirmed in the human study.