

Aerobically generated CO₂ stored during early exercise

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Abstract

Previous studies have shown that a metabolic alkalosis develops in the muscle during early exercise. This has been linked to phosphocreatine hydrolysis. Over a similar time frame, the femoral vein blood pH and plasma K(+) and HCO₃ concentrations increase without an increase in PCO₂. Thus CO₂ from aerobic metabolism is converted to HCO₃ rather than being eliminated by the lungs. The purpose of this study was to quantify the increase in early CO₂ stores and the component due to the exercise-induced metabolic alkalosis (E-I Alk). To avoid masking the increase in CO₂ stores by CO₂ released as HCO₃⁻ buffers lactic acid, the transient increase in CO₂ stores was measured only for work rates (WRs) below the lactic acidosis threshold (LAT). The increase in CO₂ stores was evident at the airway starting at approximately 15 s; the increase reached a peak at approximately 60 s and was complete by approximately 3 min of exercise. The increase in CO₂ stores was greater, but the kinetics were unaffected at the higher WR. Three components of the change in aerobically generated CO₂ stores were considered relevant: the carbamate component of the Haldane effect, the increase in CO₂ stores due to increase in tissue CO₂ and the E-I Alk. The Haldane effect was calculated to be approximately 5%. Physically dissolved CO₂ in the tissues was approximately 30% of the store increase. The remaining E-I Alk CO₂ stores averaged 61 and 68% for 60 and 80% LAT WRs, respectively. The kinetics of O₂ uptake correlated with the time course of the increase in CO₂ stores; the size of the O₂ deficit correlated with the size of the E-I Alk component of the CO₂ stores. We conclude that a major component of the aerobically generated increase in CO₂ stores is the new HCO₃⁻ generated as phosphocreatine is converted to creatine.

Key words: Adult, Aged, Bicarbonates/metabolism, Blood Gas Analysis, Carbon Dioxide/*metabolism, Creatine/metabolism, Exercise/*physiology, Female, Hemoglobins/metabolism, Humans, Lactic Acid/metabolism, Male, Middle Aged, Muscle, Skeletal/metabolism/physiology, Oxygen Consumption/physiology, Oxyhemoglobins/metabolism, Phosphates/metabolism, Phosphocreatine/metabolism, Physical Fitness/physiology, Pulmonary Gas Exchange/physiology, Research Support, Non-U.S. Gov't,

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