

高温環境下での走運動による脱水が 骨格筋内の水分子の特性に及ぼす影響

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Effects of The Dehydration on The Characteristics of Water Molecule in The Skeletal Muscles During Under Running Exercise High-temperature Environment

by

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ABSTRACT

It is known that the dehydration is a major factor of onset of the heat stroke during sports activity under high-temperature environment. However, the relationship between the dehydration and the profiles of water molecule within the skeletal muscles are poorly understood during sports activity under high-temperature. The present study examined the effects of the dehydration on the characteristics of water molecule and its related factors in the skeletal muscles during running exercise under high-temperature. In slow muscles, in running group, both the muscle water content and free water content were significantly lower than that in control group, respectively ($p < 0.05$). On the other hand, in fast muscles, there were no significant differences in these factors between both groups. Neither expression levels of AQP4 nor AQP1, that were the selective water channel, were changed in the skeletal muscles during running exercise under high-temperature. Likewise, the changes of the expression levels of $\alpha 2$ Na,K-

ATPase, which was related to osmoregulation, were induced in skeletal muscles by running exercise under high-temperature. In conclusion, the present study indicated that the prime mover, i.e. slow muscles but not fast muscles, were induced significant loss of water, particularly free water, due to the dehydration during running exercise under high-temperature. On the other hand, it was suggested that the dehydration during running exercise under high-temperature may not participate in the regulation of the selective water channel AQP4 and AQP1 expression in both fast and slow muscles. Furthermore, it was suggested that the dehydration during running exercise under high-temperature may directly not induce the change of the intracellular osmotic pressure due to the change of $\alpha 2$ Na,K-ATPase expression levels. These findings indicated in the present study may be useful to understand the molecular properties of skeletal muscles in the heat stroke during sports activity under high-temperature environment.

要 旨

高温環境下のスポーツ活動による脱水が熱中症発症の主要因であることは広く知られている。本研究では、高温環境下で走運動より脱水が生じたラットの骨格筋における水分子、およびその関連因子の特性について検討した。高温環境下で走運動を行った結果、速筋（前脛骨筋）の水分含有率および自由水量に有意な変化は認められなかった。一方、遅筋（ヒラメ筋）においては、水分含有率および自由水量が高温環境下での走運動により有意に低下した。骨格筋における水分子輸送機構である AQP4 および AQP1、ならびに水分子を活用した浸透圧調節機構である $\alpha 2$ Na, K-ATPase の発現レベルに有意な変化は認められなかった。以上、本研究は、高温環境下の走運動による脱水により、主動筋では筋内の自由水を中心に水分子が著しく喪失することを明らかにした。一方、脱水は、水分子輸送機構や浸透圧調節機構を構成するタンパク質の発現レベルには影響を及ぼさない可能性が示唆された。