有酸素運動トレーニングが活動筋の酸素供給と消費のバランスに及ぼす効果

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Effects of Aerobic Exercise Training on Balance for Oxygen Delivery and Utilization of Exercising Muscles

by

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ABSTRACT

To investigate effects of aerobic exercise training on balance for oxygen delivery and utilization of exercising muscles, the relationship between muscle deoxygenation

（HHb）and activation was examined in 3 different muscles of the quadriceps during cycling ramp exercise. Seven young aerobic-trained and seven untrained male adults pedaled at 60 rpm to exhaustion, with a work rate（WR）increase of 20 W/min. At the vastus lateralis（VL），rectus femoris（RF）and vastus medialis（VM），muscle deoxygenation and activity were measured by time-resolved near-infrared spectroscopy（NIRS）and surface electromyography（EMG），respectively. Muscle deoxygenation was corrected for adipose tissue thickness and normalized to the amplitude of the HHb response. Muscle deoxygenation and activation were then plotted as a percentage of maximal work rates（%WRmax）. The HHb responses for all three muscle groups showed sigmoid function, which were determined as the best fitting model. The RF muscle demonstrated a“right shift”of the HHb response compared to VL and VM throughout the majority of the ramp exercise. There existed no significant differences of the HHb response per se between the aerobic-trained and untrained subjects. However, the spatial heterogeneity of HHb responses per unit of muscle activity in different muscles of the quadriceps was greater in the trained subjects compared with the untrained subjects. These data suggest that greater oxygen delivery of the trained subjects might not have improved the regional balance for oxygen delivery and utilization in different muscles of the quadriceps during ramp-incremental exercise.

要　旨

時間分解・近赤外分光装置を用いて，活動筋の複数部位における脱酸素化ヘモグロビン＋ミオグロビン（HHb）を計測し，有酸素運動トレーニングが活動筋の酸素供給と消費のバランスに及ぼす効果を考察した．ランプ負荷運動において，外側広筋，大腿直筋，および内側広筋のHHbは，運動強度の増加に伴ってシグモイド状に増加した．同じ運動強度では大腿直筋のHHbが他の筋肉に比べてより低い値を示した．大腿筋の3部位においてHHbの空間的な不均一性が認められたが，有酸素運動トレーニング者と非トレーニング者の間には有意な差はなかった．有酸素運動トレーニング者における単位筋活動あたりのHHb空間不均一性は，非トレーニング者に比べてより高いことが示された．有酸素運動トレーニング者では，動員される活動筋毛細血管と筋細胞の間の酸素分圧差が非トレーニング者に比べてより大きいので，上記の空間的不均一性が改善されなかった可能性も示唆された．