

加齢により減弱したインスリン作用を改善する 運動トレーニング効果に関する研究

愛知学院大学 長崎 大
 (共同研究者) 名古屋工業大学大学院 下村 吉治
 名古屋大学総合保健 押田 芳治
 体育科学センター
 愛知学院大学 佐藤 祐造

Effects of Aging and Exercise Training on Insulin Signaling Molecules in Rat Skeletal Muscle

by

Masaru Nagasaki, Yuzo Sato
Department of Physical Science,
Faculty of Psychological and Physical Science, Aichi Gakuin University
 Yoshiharu Oshida
Research Center of Health,
Physical Fitness and Sports, Nagoya University
 Yoshiharu Shimomura
Department of Materials Science and Engineering,
Shikumi College, Nagoya Institute of Technology

ABSTRACT

It is well established that peripheral insulin resistance is exacerbated by aging and sedentarism. On the other hand, long-term exercise training prevents the aging-induced decrease in insulin sensitivity. The training effects represented by improved insulin action in vivo are attributed largely to changes in muscular factors such as increased muscle volume, increased rate of blood flow in the exercising muscle, and changes in the post-insulin receptor mechanisms. However, little is known about the responses to short-term exercise

training of muscular insulin signaling molecules such as insulin receptor, insulin receptor substrate-1 (IRS-1), phosphatidylinositol 3-kinase (PI 3-kinase), 3-phosphoinositide-dependent protein kinase 1 (PDK-1), and Cbl. In the present study, we examined the effects of aging and short-term exercise training on the protein contents of insulin signaling molecules in rat skeletal muscle. Female Sprague-Dawley rats (7 and 27 wk old) were divided into 2 groups. One half of the rats in each group was kept sedentary (SED) and another half was trained (TR) by swimming exercise. Rats in the training group were swim-trained for 5 days. Dissection procedures to obtain gastrocnemius muscle were carried out approximately 16 h after the last bout of exercise. The contents of the gastrocnemius insulin signaling molecules were determined by Western blotting. Aging and exercise training did not affect the content of insulin receptor, PI 3-kinase, PDK-1, and Cbl, proteins in rat skeletal muscle. On the other hand, while the IRS-1 protein in sedentary rats was significantly decreased with aging (53 % at 27 wk of age relative to the abundance at 7 wk of age), it was not affected by aging in trained animals (TR-7wk: 92%, TR-27wk: 68%). These results suggest that the improvement in insulin sensitivity by training may be due, at least in part, to regulation on the IRS-1 protein content in skeletal muscle.

要 旨

【目的】運動トレーニングが加齢に伴うインスリン感受性の低下を防止することは周知の事実であるが、その機序については不明な点が多い。本研究では、インスリン情報伝達に關与するタンパク量に対する加齢と運動トレーニングの影響について検討した。【方法】7および27週齢のSD系雌性ラットをそれぞれ安静（S）群と運動トレーニング（T）群に分け、T群には水泳運動を5日間行わせた。最終の運動終了後16時間で腓腹筋を摘出し、インスリン受容体、IRS-1、PI 3-kinase、PDK-1およびCblのタンパク量を Western blotting 法により測定した。【結果】IRS-1のタンパク量は、S群では加齢に伴い有意に低下したが（ $p < 0.05$ ）、T群では有意な加齢の影響を受けなかった。すなわち、S群の7週齢（100%）に比してS群の27週齢では53%であり、T群の27週齢では68%であった。一方、インスリン受容体、PI 3-kinase、

PDK-1およびCblのタンパク量は、加齢および運動トレーニングの影響を受けなかった。【まとめ】以上の成績より、加齢によるインスリン感受性低下に対する運動トレーニングの改善効果には、骨格筋におけるIRS-1タンパク量の調節が關与している可能性が示唆された。