

筋の退行性変化に対する運動の抑制と加齢の影響

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Effects of Exercise and Ageing on Soleus Muscle Atrophy Induced by Hindlimb Suspension in Rats

by

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ABSTRACT

We investigated the effect of exercise on muscle atrophy and histo-pathological changes induced by hindlimb suspension (HS) as an experimental model of disuse in 4-, 10-, and 20-months old rats. Maximum tetanic tension (Pmax) of the soleus muscle (SOL) decreased significantly with HS but the degree of tension decline did not differ between three age groups (70, 76, 75% in 4-, 10- and 20- months old, respectively). This decrease was more pronounced than a decrease in muscle wet weight (39-41%) and fiber cross-sectional area (55-61%). In SOL of HS, core-like lesions and ragged-red fibers appeared in addition to muscle fiber atrophy. Also, interstitial space increased with HS. These changes were observed at any age. Therefore, the tension decline due to HS was responsible for muscle fiber atrophy and pathological changes. Isometric exercise (30 minutes per day, 6 days per week) during HS counteracted tension decline, but less effective in 20-months old than 4- months old. Muscle fiber atrophy and pathological changes decreased with isometric exercise. Pmax per total fiber cross-sectional area of suspended-exercised groups was similar to that of control group in 4-months old rats but was lower in 20-months old rats. Consequently, it was assumed that the factors other than suppression of muscle fiber atrophy were associated with age-related difference in effect of exercise on tension decline.

要 旨

若年（4ヶ月齢）、中年（10ヶ月齢）、老年（20ヶ月齢）ラットに後肢懸垂を実施し、活動制限による骨格筋の萎縮に対するアイソメトリック筋運動の影響を検討した。いずれの加齢段階においても、後肢懸垂によりヒラメ筋の最大張力は、70-76%低下した。この張力低下は、筋線維断面積の減少（55-61%）や筋線維の変性によって生じることが示された。後肢懸垂期間中に、1日30分間の等尺性荷重負荷を行うことにより、後肢懸垂によるヒラメ筋の張力低下は抑制されたが、その効果は、加齢に伴い低下する傾向がみられた。若年期では、筋線維横断面積と筋張力に対する荷重負荷の抑制効果は同程度であったが、中年、老年期では、筋線維横断面積の減少抑制から荷重負荷による筋張力減少抑制を説明することはできなかった。したがって、筋線維の萎縮抑制以外の要因に対する運動効果の違いにより、荷重負荷による張力低下抑制の加齢差がみられたと考えられた。