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Effects of one-time exhaustive exercise on peripheral drive in rats

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Objective In this study, we observed the effects of one-time exhaustive exercise on the grip strength, the time of grabbing, and the changes of the electromyography (EMG) of the hind limb flexor muscles and the flexor elbow muscles of the forelimbs, and revealed the effects of exercise fatigue on the peripheral motor drive level.
Methods Male SD rats finished exhaustive fatigue exercise. A one-time exhaustive treadmill exercise fatigue model was established after one-week adaptive training in rats. The model was established by the modified Bedford incremental load motion program of the laboratory. The load is divided into 3 levels: the first stage movement speed 8.2 m/min, exercise time 15 min; second stage speed 15 m/min, exercise time 15 min; third stage speed at 20 m/min, exercise to exhaustion. At the same time, a miniature wireless acceleration sensor (18g) was worn in the tail of the rat to monitor the acceleration change of the running direction of the rat while running on the running platform. Three consecutive parallel experiments were performed using a rat grip tester (BioSEB GS3) to measure and compare the maximal muscle strength changes of the limbs before and after exercise fatigue in rats. Compared the static contraction of the rat muscle before and after exercise fatigue to overcome the length of time and gravity of the rod, and evaluated the muscle endurance after training the rats to learn to grab the rod. The EMG,square root amplitude (maxRMS), frequency domain analysis of EMG median frequency (MDF) and mean frequency (MPF) of the hind limb flexor and the forelimb flexor muscles (EMG) was measured by the Italian BTS FREEEMG ultra-miniature wireless surface electromyography tester to predict peripheral muscle tone and drive level.
Results 1) The maximum holding force of the rat in resting state was 68.53 N/Kg, and the gripping force was significantly decreased ($p<0.05$) and reduced to 25.47 N/Kg after exercise fatigue .2) Exercise fatigue has a significant effect on the static grab time of rats. The rat has a grab time of 287.65s in a quiet state, and can only last for 27.78s after fatigue, and even can hardly maintain static contraction. The maxRMS of hindlimb flexor muscles in rats was significantly lower than that before fatigue ($P<0.05$) at rest, and there was no difference in forelimb flexor elbow muscle groups. MDF and MDF of forelimb flexor elbow muscle group and hind limb flexor muscle group were significant increased ($P<0.05$). 4) MaxRMS MDF and MDF of hind limb flexor muscle group and forelimb flexor elbow muscle group were significantly lower than those before fatigue ($P<0.05$) under the state of grabbing rod.
Conclusions The sprinting ability in the running direction,maximum gripping force and grabbing time of the rats decreased significantly after exercise fatigue, revealing that the fatigue of the muscles may cause the decrease of the muscle static contraction ability. The inability of the hind limbs to maintain standing with exercise fatigue may be related to a significant decrease in hindlimb tension, and it was found that there was an explosive discharge and the phenomenon of tonic contraction in the muscles at rest. The muscle endurance and tension of the muscles were significantly reduced, and the contraction frequency of the muscle movement unit decreased significantly after exercise fatigue, causing insufficient peripheral driving level . (NSFC31401018, SKXJX2014014, Corresponding_houlj@bnu.edu.cn).