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低强度激光对大鼠力竭运动后骨骼肌自由基、NO代谢的影响
 刘晓光^{1, 2}, 周永健¹, 夏义山¹, 袁建琴¹, 刘承宜^{1, 2}

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(1. 华南师范大学 激光运动医学实验室, 广东 广州 510631; 2. 华中科技大学
 所, 湖北 武汉 430074)

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摘 要：采用跑台下坡跑模型，研究了不同剂量的低强度氦氛激光对大鼠力竭运动后骨骼肌自由基、一氧化氮(NO)代谢的影响。72只SD大鼠随机分成安静对照组，运动对照组中、高剂量激光处理组。各运动组的大鼠均进行一次性跑台力竭运动，运动加激动后于腓肠肌处接受氦氛激光照射，每日1次，各剂量组照射参数分别为12、28和46和71 mW/cm², 10 min)。运动后24和48 h进行腓肠肌取材，检测指标为肌肉超氧化物歧化酶(SOD)、丙二醛(MDA)、一氧化氮合酶(NOS)以及一氧化氮(NO)。结果发现，力竭运动组的MDA水平和NOS活性显著升高，而SOD活性和NO变化不明显。43 J/cm²的激光照射运动后的SOD活性、降低MDA水平以及显著提高NOS活性和NO水平，而12和28 J/cm²作用不明显。由此表明，低强度氦氛激光能够提高大鼠力竭运动后骨骼肌抗氧化自由基水平，并能促进骨骼肌NO的合成，提高NO水平，其作用是剂量和强度依赖性的。

关 键 词：运动生物化学；低强度激光；光生物调节作用；自由基；一氧化氮；

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Effects of low-level laser irradiation on the metabolism of free radicals and nitric oxide of rat skeletal muscle after exhaustive exercise
 LIU Xiao-guang^{1, 2}, ZHOU Yong-jian¹, XIA Yi-shan¹, YUAN Jian-qin¹, LIU Cheng-yi^{1, 2}

(1. Lab of Laser Sports Medicine, South China Normal University, Guangzhou 510631, China; 2. Institute of Biomedical Photonics, Huazhong University of Science and Technology, Wuhan 430074, China)

Abstract: This study has investigated the effects of low-level He-Ne laser irradiation at different doses on the metabolism of free radicals and nitric oxide in skeletal muscle after exhaustive exercise by using the animal model of Sprague-Dawley rats. Seventy-two Sprague-Dawley rats were randomly divided into five groups: control group, exercise group, exercise + low-dose laser group, exercise + medium-dose laser group, and exercise + high-dose laser group. After exhaustive exercise, the rats were irradiated with He-Ne laser at different doses (12, 28, 46, and 71 mW/cm²) for 10 minutes daily. The rats were sacrificed 24 and 48 hours after exercise, and the skeletal muscle was taken for analysis. The indicators measured were superoxide dismutase (SOD), malondialdehyde (MDA), nitric oxide synthase (NOS), and nitric oxide (NO). The results showed that the MDA level and NOS activity were significantly increased in the exhaustive exercise group, while SOD activity and NO level were not significantly changed. After laser irradiation, the SOD activity was significantly increased, the MDA level was significantly decreased, and the NOS activity and NO level were significantly increased. These results indicate that low-level He-Ne laser irradiation can increase the antioxidant free radical level of skeletal muscle after exhaustive exercise and promote the synthesis of NO, thereby increasing the NO level. The effect is dose- and intensity-dependent.

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ry control group, exercise control group, exercise + low-dose laser group + medium-dose laser group, and exercise + high-dose laser group. Each exercise control group and the three exercise plus laser groups performed exhaustive downhill running on treadmill. Three exercise plus laser groups received laser irradiation after exercise at gastrocnemius muscles daily. The parameters for three different dose laser groups were 12, 28, and 43 J/cm² (71 mW/cm², 10 min), respectively. Gastrocnemius muscles were sampled 8 h after exercise. Muscle superoxide dismutase (SOD), malondialdehyde (MDA), nitric oxide synthase (NOS) and NO were analyzed. The exercise control group exhibited significant elevations in muscle MDA level and NOS activity after exhaustive exercise. Laser irradiation at 43 J/cm² significantly enhanced muscle SOD activity and NO level and significantly reduced muscle MDA level after exercise. The effects of the irradiation at 12 or 28 J/cm² were unmarked. In conclusion, laser irradiation could enhance muscle anti-oxidative capacity and reduce free radicals level, and promote to synthesize NO and increase NO level in a dose-dependent manner.

Key words: exercise biochemistry; low-level laser; photobiomodulation; nitric oxide; exhaustive exercise

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