MAPK SIGNALING PATHWAY ACTIVATION RESPONSE TO A SINGLE BOUT OF EXERCISE IN UNTRAINED AND TRAINED HEART OF RATS
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Gene and protein expressions participate in a causal mechanism of exercise training-induced physiological cardiac hypertrophy. We recently showed gene expression profiling of the exercise-induced hypertrophic heart in rats. Mitogen-activated protein kinase (MAPK) signaling pathways, such as extracellular signal-regulated kinase (ERK), c-Jun N-terminal kinase (JNK) and p38 MAPK (p38), play a critical role for cellular hypertrophy. Additionally, MAPK kinase (MAPKK), such as MEK1/2, SEK and MKK3/6, is upstream signaling pathway to activate MAPKs.

PURPOSE: As exercise training causes cardiac hypertrophy, and a single bout of exercise induces mechanical stress to the heart, the present study aimed to characterize the activation patterns of multiple MAPK signaling pathways in the heart after a single bout of exercise or exercise training.

METHODS: The hearts of untrained rats received 5, 15 and 30 min treadmill running exercise (Ex5 – Ex30) and rested for 0.5, 1, 3, 6, 12, and 24 h (PostEx0.5 – PostEx24, each group of N = 6) before subjecting them to the following different experiments. Additionally, to investigate MAPK and MAPKK activation responses to an acute bout of exercise in the heart of chronically exercise trained rats, the trained rats received exercise training were randomly divided resting control and 30-min exercise after 4, 8 or 12 weeks exercise training.

RESULTS: Activation of MAPKs (ERK, JNK and p38) and MAPKKs (MEK1/2, SEK and MKK3/6) increased immediately after acute exercise in a time-dependent manner, with ERK, JNK, p38, MEK1/2, SEK and MKK3/6. The elevated levels of MAPKs and MAPKKs declined to the resting levels within 24 h after exercise. In another set of experiments, following a 4-, 8-, and 12-week exercise training, the rats exhibited significant cardiac hypertrophy by week 12. Left ventricular weight and myocyte surface area were significantly higher in the 12-week-trained rats compared to the age-matched sedentary rats, while unchanged in 4- or 8-week exercise-trained rats. Activation of MAPKs and MAPKKs in the 4-week trained rats increased after 30-min single bout of exercise, but decreased in the 8-week group. Finally, the activity of MAPKs and MAPKKs signaling in the 12-week trained rats exposed to an acute bout of exercise was unaltered.

CONCLUSION: We conclude that exercise induces the activation of multiple MAPK signaling pathways in the heart, an effect that gradually declines with the development of exercise-induced cardiac hypertrophy.

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