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Effect of Aerobic Exercise on the Expression of CaMKIIδ/MEF2 in Hypertensive and Physiological Cardiac Hypertrophy

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Objective The type II calcium/calmodulin-dependent protein kinase IIδ (CaMKIIδ) signal plays a key role in the development of cardiac hypertrophy. This study used CaMKIIδ as an entry point to investigate the mechanism of moderate-intensity aerobic exercise affecting myocardial function.
Methods Male spontaneously hypertensive rats (SHRs) and Wistar-Kyoto rats (WKYs), 12 weeks age, were randomly divided into aerobic exercise group (SHR-EX/WKY-EX) and sedentary control group (SHR-SED/WKY-SED), with 12 rats in each group. The aerobic exercise group conducted an 8-week treadmill exercise training with a slope of 0°, 20m/min (about 55-65% of maximal aerobic velocity), 60min/day, and 5d/wk. The control group did not exercise. The body weight of each group of rats was measured weekly and the blood pressure of the rats was measured non-invasively. After 8 weeks, the hearts of SHR-EX group, WKY-EX group, SHR-SED group and WKY-SED group were weighed, and then myocardial tissue sections were taken for HE staining to observe the thickness of the ventricular wall and the morphology of myocardial cells. The expression of CaMKIIδ and MEF2 in each group was determined by Western blotting.
Results (1) The body weight of SHR-SED group was significantly higher than that of SHR-EX group ($p<0.01$), and the heart weight of rats in exercise group changed significantly. The WKY-EX group had greater heart weight than the WKY-SED group, and the SHR-SED group was heavier than the SHR-EX group ($p<0.05$). The heart weight/body weight ratio of the WKY-EX group was significantly higher than that of the WKY-SED group ($p<0.01$). The heart weight/body weight ratio of SHR-EX group and SHR-SED group was higher than that of WKY-EX group and WKY-SED group ($p<0.01$). (2) Compared with the WKY-SED group, the SHR-SED group had loose interstitial cells and increased single cell area. The SHR-EX group is more compact than the SHR-SED group, and the cell cross-sectional area is reduced. (3) The expression of CaMKIIδ protein in SHR-EX group was significantly lower than that in SHR-SED group ($p<0.01$), but the expression level of CaMKIIδ in WKY-EX group was significantly higher than that in WKY-SED group ($p<0.01$). The expression level of CaMKIIδ was significantly higher in the SHR-SED group than in the WKY-SED group. In addition, the expression of MEF2 protein in SHR-EX group and WKY-SED group was significantly lower than that in SHR-SED group ($p<0.01$), while the MEF2 expression level in WKY-EX group was higher than WKY-SED group and SHR-EX group ($p<0.05$).
Conclusions There is an interaction between aerobic exercise and hypertension. Aerobic exercise can effectively delay the development of hypertensive cardiac hypertrophy by regulating the expression of CaMKIIδ and MEF2 protein in the myocardium, but it can also cause cardiac hypertrophy in normal heart. It is one of the important mechanisms affecting the myocardial morphology and function.