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Electrophysiologic investigation of exercise-induced cardiac hypertrophy in a rodent model of athlete's heart

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Funding Acknowledgements: NKFIH (K 120277), ÚNKP-17-4 (to A.O.), SIA-KF-17 (to A.O.)

Although regular exercise training is associated with cardiovascular benefits, cardiac remodeling induced by long-term, intense exercise training is also related to increased risk of arrhythmia. We aimed at providing electrophysiologic investigation of exercise-induced myocardial hypertrophy in a rat model of athlete's heart and determining sex-specific differences.

Age-matched young adult rats were divided into female exercised (FEx), female control (FCo), male exercised (MEx) and male control (MCo) groups. After exercised animals completed a 12-week-long swim training protocol, echocardiography was used to confirm exercise-induced hypertrophy. In vivo electrophysiologic investigation was performed by programmed stimulation with an octapolar catheter inserted into the right atrium.

Myocardial hypertrophy was verified by left ventricular mass (echocardiography) and post-mortem heart weight data in both exercised groups. We found signs of atrial remodeling in female exercised rats (right atrial weight: 42.3 ± 3.6 g FEx vs. 19.5 ± 1.5 g FCo, $p < 0.05$), increased P-wave duration and amplitude, as well as altered right atrial effective refractory period. We also observed increased T-wave amplitude and QT interval in female swim-trained rats. Hearts of male exercised rats were primarily associated with increased RIR duration and Wenckebach cycle length (WCL: 109.8 ± 4.7 ms MEx vs. 97.3 ± 2.1 ms MCo, $p < 0.05$) compared to control ones. Exercise training was related to increased R wave amplitude and QRS duration in both genders and we could induce non-sustained atrial flutter in two (one male and one female) exercised animals by double extrastimulation.

Our data suggests that exercise-induced cardiac hypertrophy might hold an increased risk of arrhythmia. In male individuals elevated parasympathetic tone, while in female ones marks of atrial remodeling could be the characteristic alterations.